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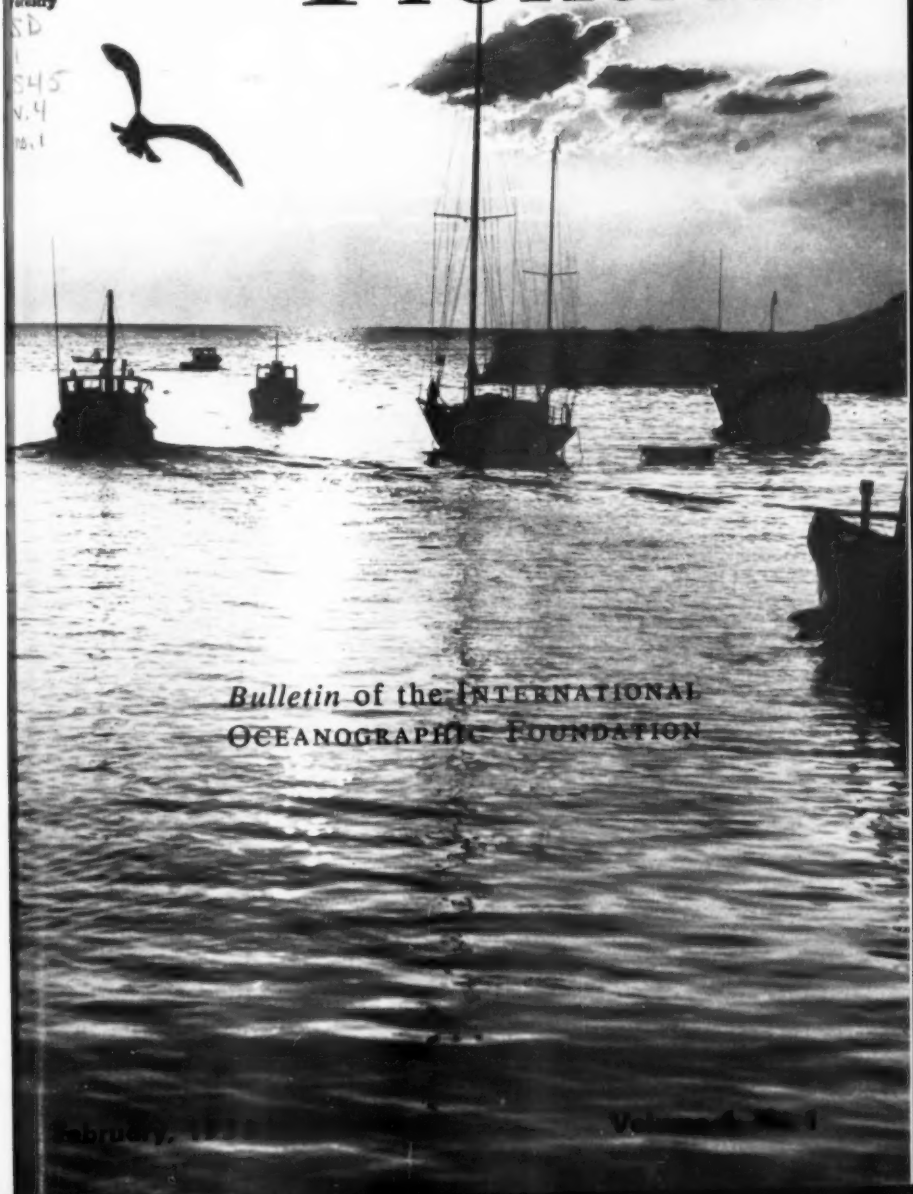

Bulletin of the INTERNATIONAL OCEANOGRAPHIC FOUNDATION

February, 1[illegible] Volume 4, No. 1

ANOTHER OLD MAN OF THE SEA? *From Wilmington, N.C., comes this odd picture of an oyster attached to a clam. Why unusual? Because both creatures were reported alive when found. How did the oyster, normally attached to shells or rocks on the surface of the sea-bottom, survive being dragged deep into the mud, where clams normally live? (Star-News Newspapers)*

FRONT COVER. Fishermen greet the dawn. *It is just after sunrise at Rockport, Massachusetts, and a small fleet of craft set forth to try their luck against the creatures of the sea. (Massachusetts Department of Commerce)*

BACK COVER. One of the larger *research vessels cooperating in oceanographic studies during the International Geophysical Year is* Discovery II, *of the National Institute of Oceanography, Great Britain. Here, after an Atlantic crossing, she refuels at Port Everglades, Florida. (E. John Long)*

SEA FRONTIERS

Bulletin of the INTERNATIONAL OCEANOGRAPHIC FOUNDATION

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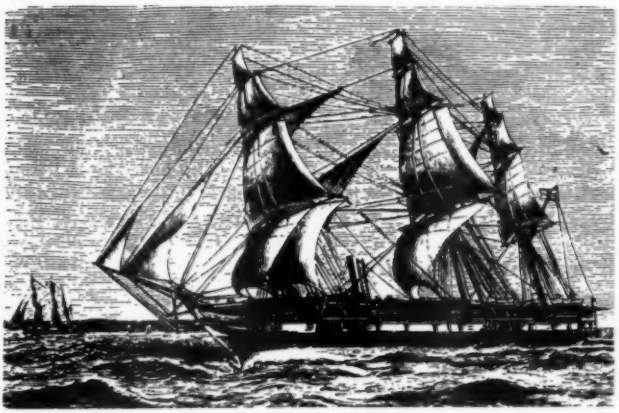

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INTERNATIONAL COOPERATION *in oceanography is encouraged by UNESCO through meetings held in various countries. Delegates to a UNESCO meeting at Montemar, Chile, are shown above. They are, left to right, Dr. Juan Ibanez, UNESCO director for the Latin Americas; Dr. Roger Revelle, La Jolla, Cal.; Dr. Parmenio Yañez, Montemar, Chile; Dr. F. G. Walton Smith, Miami, Fla.; Dr. Anton Bruun, Denmark; Dr. Erwin Schweigger, Peru; and Dr. Paule Sawayo, São Paulo, Brazil.*

United By Ocean

THE HUGE expanses of water which separate the continents are unquestionably a physical barrier to the free intermingling of peoples. Yet science and scientists are international in outlook and their common interests form a link between nations. In no science is this so desirable as in the study of the oceans. Thus the seas which divide mankind should also serve to unite it.

Seventy Ship Expedition

The subject of international cooperation in oceanography is receiving more than usual attention today because of the International Geophysical Year, a common effort which has already been given considerable space both in *Sea Frontiers* and in the general press. It is sufficient here to say that it represents the first world-wide attempt to coordinate scientific observations in all of the oceans of the world, with about seventy research vessels engaged at sea and a number of special stations established on the mainland and on islands.

Outside of the Geophysical Year perhaps the best example of this spirit of joint inquiry is the International Council for the Exploration of the Sea. This was established about 50 years ago as a collaboration between the countries of northern Europe, primarily for the purpose of scientific study of the North Sea and the devel-

opment and control of the North Sea Fisheries. One result of this was considerable stimulus towards oceanographic, marine biological and fishery investigations by the countries concerned, which have in many ways laid the foundations of these sciences for the whole world.

Offshore Research Costly

Unfortunately the development of international cooperation has been very much slower where the open ocean is concerned. There are several reasons for this. In the first place the study of the deep sea floor or the mid-ocean waters has no immediate commercial value comparable to that of the North Sea fisheries and therefore the demand and the financial support for such work has not been great. Moreover, the organization for offshore scientific research and the availability of trained personnel and properly equipped vessels have been developed to very unequal levels in the various countries. This also hinders effective cooperation. Yet such cooperation is needed, for the very considerable cost of widespread oceanic investigations is beyond the financial ability of any one country.

Seas of Air and Water

That other great ocean, the atmosphere, has streams and fast flowing currents, whose relation to weather forecasting is clear and obvious. It is not surprising then, that international cooperation in meteorology has grown considerably. The international network of meteorological stations has no exact counterpart in oceanography. Yet the ocean is almost as universal as the atmosphere in its extent and is similarly difficult to divide into isolated areas. The Gulf Stream off Florida carries heat to modify the climate of Northern Europe and the water which reaches the coast of California has previously flowed past the islands of Japan.

The scarcity of really effective cooperative investigations has been less noticeable in the North Sea and the Mediterranean, where distances are less, the countries are closer to the problems and the local fisheries provide a commercial stimulus to research. Similarly a fair knowledge has been gained of the more heavily travelled North Atlantic and Eastern Pacific Oceans. But when we turn to the southern part of the South Atlantic, the mid-Pacific and the Equatorial regions generally, the gap in knowledge is noticeable. In the case of the Indian Ocean and South Pacific more scientific knowledge is especially desirable. In the study of the deep sea floor such expeditions as those of the *Galatea* and *Albatross,* organized by individual countries, but with international participation of scientific personnel, are the more noticeable because of their rarity.

The commercial importance of shipping led to the formation of the International Hydrographic Bureau, which is concerned mainly with collecting information on ocean currents and matters important to navigation. There are also a number of international commissions of recent origin which are concerned with the problems of fisheries, somewhat after the fashion of the International Council for the Exploration of the Sea. The

Pan American Institute of Geography and History includes oceanography in its fields of interest. There are other organizations of comparatively recent origin, such as the International Association of Physical Oceanography and an oceanographic committee under the International Council of Scientific Unions.

International Organizations Multiply

The most recent efforts to improve the situation are those of the United Nations. UNESCO, its scientific and cultural organization, has with FAO, the food and agricultural organization, undertaken to assist the development of marine sciences in countries where they have been largely neglected. The plans going forward include the provision of an international oceanographic vessel which will allow scientists from several countries to participate in the study of the less well-known areas.

Aid for Students

Behind the interest of the United Nations lies the need for scientific knowledge on which to base fisheries development as well as knowledge for its own sake. Thus, meetings have been held in countries where marine science requires further development, and special training sessions have been held along with meetings of the International Committee on Marine Science in such countries. Fellowships are provided in order to send students and teachers to the laboratories of more advanced countries for professional instruction.

International cooperation and the efforts of international groups, committees and councils cannot reach their full value until the countries which they seek to help have acquired well-trained scientific leadership. It is therefore becoming apparent that the international fellowship program may be the key to the future of oceanography on an international scale. The stimulus of meetings held in Bangkok or Valparaiso is apparent for a while, but the sustained support of the home government is necessary for any continued development or stability. Leadership and trained scientists must remain behind to keep such support and interest alive.

International Institutes Needed

Research on an international scale, like any other research, rests upon the ideas and scientific imagination of individuals, so that the problem of adequate training is of world wide importance, not merely of special interest to those countries in which oceanography has been neglected.

The solution may lie in the provision of special training facilities or the modification of existing facilities so as to provide international schools of oceanography, each serving a considerable area of the world. The Near and Far East and the Indian Ocean form a natural group. The Atlantic Ocean linking Africa, Central and South America and the Caribbean is another such unit, the entire Pacific still another. At Stockholm the United Nations supports an International Meteorological Institute. Perhaps this should be followed by three or perhaps four International Oceanographic Institutes to serve the areas mentioned.

AT ANCHOR OFF ROBINSON CRUSOE ISLAND *in Cumberland Bay, Más a Tierra, lies the* Ester B. *The expedition's ship, a former seiner-trawler, was well suited to collecting fishes and making studies of other marine life along the steep shores of the Juan Fernández group. (John Manning)*

"Robinson Crusoe" Waters

By JOHN MANNING
Field Associate, The Marine Laboratory,
University of Miami

THE JUAN FERNANDEZ group is no easy goal. Its small volcanic islands thrust their rocky heads from the vast expanse of the southeastern Pacific some 400 miles west of Valparaiso, Chile. Far from today's trade routes, they have neither plane nor regular ship service. The only harbors are little more than open roadsteads.

Little wonder that when Alexander Selkirk was put ashore there, and remained alone for four years, the account of his experiences inspired Daniel Defoe to write *Robinson Crusoe*, the classic narrative of man's struggle for survival on a remote island. For the marine scientist, the angler, or the commercial fisherman, however, Juan Fernández has its own especial fascination.

Blank Spot in Marine Biology

Today the Juan Fernández, which belong to Chile, have a few permanent inhabitants who carry on a small

commercial fishery. But the stormy waters surrounding the islands remained one of the blank spots in marine biology until the arrival of the University of Miami-John Manning expedition there early in 1957. While the objective was more or less limited to the distribution of commercial fishes and the nature of the inshore life, it was nevertheless the first organized marine research done in this area.

Argosy for the voyage from Chile was the stout, iron-hulled *Ester B*, a 66-foot purse seiner, which had been built in the Pacific northwest as a seiner-trawler. She really wasn't much to look at, and her accommodations were on the rugged side. But her powerful diesel engines drove her steadily through calm and stormy seas, and because she had been used in salmon fishing, the *Ester B* could carry 20 tons of ice, more than enough to preserve even the largest fish specimens.

Fourth Year of Research

The 1957 expedition to the Southeast Pacific marked my fourth year of work as a Field Associate of The Marine Laboratory, University of Miami, studying the distribution of billfishes, tunas, and other marine life in this lonely area which comparatively few people have visited.

This trip was arranged in collaboration with the University of Chile. One of the expedition's scientists, Eduardo Ormeño V., came from Talcahuano, Chile, and another, Gilberto Rodriguez, a native of Venezuela, was a graduate student of the University of Miami's Marine Laboratory. To complete the staff there was my wife "Jo," whose enthusiasm for oceanic studies equals my own.

Off For Mas a Tierra

The early morning of February 13, 1957, found the expedition with all gear and supplies on board, and the *Ester B* ploughing through the rough chop of Valparaiso harbor, outward bound. The Southern Hemisphere summer was waning and the prevailing trade winds blew brisk and strong from the southwest. We turned the prow of the *Ester B* on a course almost due west for Más a Tierra, the largest island of the Juan Fernández group and the nearest one to the South American mainland.

One of our objectives en route was to make some studies of the Humboldt Current, that mighty northward flowing river of the sea which originates in cold antarctic waters and runs along the west coast of South America. Deep sea soundings were made by bathythermograph at twenty different stations, and surface temperatures and salinity readings were taken at numerous points where the sub-antarctic and warmer waters converge. These, along with estimates of the drift of the current, were forwarded to Miami, and later to the Hydrographic Office in Washington, D.C.

A Mystery Fish!

It was nearly in the middle of the Humboldt Current that we had our first adventure. A large dead fish was observed floating on the surface. It appeared to be white or some pale color. This is such a rare occurrence that we hove to and picked it up. The creature had a somewhat truncated body, about five feet long, and its

light colored scales indicated that it was a dweller of the depths whose denizens are either white or black, or one that might approach the surface only during hours of darkness or would float up after death.

Because no one on board could identify it, we packed the odd creature in ice, so that its head and other important parts might be shipped back to the Marine Laboratory for preliminary study, and later sent to the American Museum of Natural History for final identification.

Largest of its Kind

Comparison with other fishes of the Pacific, and preliminary study at Miami, indicated fairly conclusively that the fish is of the family *Brotulidae,* which belongs to a group related to the deepwater cod. This is a rare, but not entirely unknown fish, and it will be interesting to know if more detailed study determines whether it is a new species. At any rate it is by far the largest fish of this family ever described.

STRANGE DWELLER OF THE DEPTHS. *En route to Juan Fernández an odd fish, floating on the surface, was picked up. Preliminary study indicates that it is of the family* Brotulidae, *and is probably related to the deep water codfishes. (John Manning)*

Cumberland Bay

We raised the jagged peaks of Más a Tierra in pre-dawn darkness, February 15, but awaited daylight before approaching the island. Soon the *Ester B* swung to anchor in curving, mountain-walled Cumberland Bay. The tiny settlement, one of two in the islands, seemed to cower in the shadow of the cloud-capped summits that rear so steeply behind it.

After the usual formalities ashore, and a brief inspection of the fish packing plants, we launched into our study of the bottom and non-migratory fishes of the surrounding waters, as well as such deep-sea fish as could be obtained in offshore trips. Because the bottom everywhere drops off sharply, with few shoal areas near the rocky coasts of the islands, we did not have to go far to reach the realm of many pelagic or open sea fishes.

Abundance of Yellowtail

Most specimens were obtained with the Japanese longline. This familiar and most dependable apparatus employs hundreds of hooks on leaders, placed at intervals on a buoyed line, sometimes miles long. The Japanese developed the longline for commercial fisheries, but it is still the most efficient method of collecting, for scien-

tific purposes, specimens of the larger fish, such as tuna, billfish, and the large reef types.

No Evidence of Squid

Our work with the longline soon disclosed that the waters around the Juan Fernández group contain what are probably the largest yellowtail schools, and the largest individual specimens, to be found anywhere in the world. One haul brought up 4¼ tons, of an average weight of 53.7 pounds. One yellowtail, which tipped the scales at 118 pounds, is the heaviest ever recorded.

Among the other larger fishes obtained by longline and by trolling operations were albacore, yellowfin tuna, and sharks. No evidence of marlin, sailfish or swordfish was found, nor any giant squid, that bane of the commercial fisherman. This is probably the only area in the southeastern Pacific that is free of the unwelcome giant squid, although small squid are numerous in certain seasons. Absence of giant squid means that the Juan Fernández area holds promise of greatly enlarged commercial fisheries in the future.

New Lobster Industry

Not all of our field work was with the big fishes. We obtained numerous specimens of smaller fish and plankton, that rich food of the sea. Several plankton net hauls brought up unusual marine larvae. Selections from all these activities were preserved and later shipped to the Marine Laboratory, where they will provide study material for advanced students for several years.

We also observed the taking of lobsters by local fishermen, an industry that has developed only within the last ten or twelve years. The Juan Fernández lobster is really a crawfish, but a different species from those taken in California, Florida and West Indies waters. Lobster are caught in traps or pots, and brought ashore in small boats. Some of them are canned; others are packed in ice for sale alive on the mainland, where they are in active demand. Three seafood companies have concessions granted by the Chilean government to engage in this trade.

Seeks to Expand Fisheries

Chile appears to be very anxious to expand the fisheries of these islands. With copper and nitrate production down, and inflation rampant, the country must seek cheaper sources of food, and the sea is the answer. Lack of transportation and refrigeration, however, has resulted in Chile consuming only about one eighth of the fresh seafood that is readily obtainable. Few places 50 to 100 miles inland have any regular deliveries of fish, lobsters, etc., although the country has one of the longest seacoasts.

Juan Fernández, potentially one of the richest fishing grounds in the world, is open to foreign as well as Chilean commercial fishing. In order to fish these waters, however, it is

OVER THE SIDE *comes a large sword*
The crew of the Ester B *seems to*
pleased with this fine 600-pound sp
men, taken in long-line operations
Juan Fernández. (John Manning)

necessary to have the proper Chilean licenses, for which a nominal charge is made, as well as permission from the Navy. Ships may then base on the islands and make use of the stores and other facilities there.

Tuna Most Valuable

Commercially, the most valuable of all Juan Fernández fishes are the members of the tuna family—albacore and yellowfin. Locally the most prized fresh fish is the flounder. Other fishes that should be mentioned are the bacalao and cabrilla, both groupers. There are also two jacks, the palomita and the jurel and a flounder, the lenguado. Another fish, known as sierra, is actually a snake mackerel.

The survey made by Gilberto Rodríguez of the inter-tidal and shallow water fauna and flora was an important contribution. Not only was an extensive collection of specimens secured, but for the first time marine biologists will have the material needed to determine whether the fauna and flora of the sea floor surrounding Juan Fernández were derived from oceanic or continental (South American) origins. These specimens will also provide several years of research for advanced students in oceanography.

Selkirk not Shipwrecked

During an interlude in our marine studies we went ashore to become better acquainted with Más a Tierra's historic past. One of the landmarks is an old stone fort, built by the Spaniards, now in ruins. Once, perhaps twice, it was assaulted and taken by the British, who were anxious to have the islands as a supply base.

Even more interesting is a lofty vantage point called "Selkirk's Lookout." As there are no automobiles, nor even horses, on the island, we walked up the steep winding path that leads to a simple stone marker commemorating Alexander Selkirk, the Englishman marooned on these islands for four years, 1704-09.

Contrary to general belief, Selkirk was not shipwrecked; he left the *Cinque Ports,* a galley engaged in a South Seas privateering expedition, at his own request. Upon his rescue and return to London, two English writers, Woodes Rogers and Edward Cooke, heard about and recounted his unique experiences. Later Selkirk himself issued a booklet: *Providence Displayed, or a Surprising Account of One Alexander Selkirk . . . written by his own hand.*

Once Base for Whalers

Shortly afterward, Defoe published *Robinson Crusoe,* the basic idea of which is plainly derived from Selkirk's adventure. Defoe, however, changed the locale to "an island near the mouth of the great river Orinoco," within sight of "the mountains of Trinidad." Although Defoe did not name the island, the description fits Tobago. Actually, Selkirk was by no means the first to land on Juan Fernández. The group was discovered in 1563 by the Spanish navigator, Juan Fernández, whose name it bears. For 200 years there was no permanent settlement, although ships occasionally put in for fresh water, or for the meat of goats and pigs that had been re-

LINK WITH THE MAINLAND. *Juan Fernández's canned fish and live lobsters are transported packed in ice over 300 miles of sea to Chilean markets by the* Cap Horn. *Chile, seeking cheaper food sources, is anxious to expand these fisheries. (John Manning)*

leased on the islands, and still run wild.

About 1741 the English considered colonizing the islands. Rumors of this led to the setting up of a Spanish garrison in 1750. The British were never able to gain a foothold. The islands became a part of Chile in 1818, and for many years provided a convenient repository for political exiles.

After the American Civil War, the Juan Fernández had a brief period of affluence as a base of supplies for Pacific whalers. Sealing ships from the Falkland Islands arrived about the same time, but within ten years they practically exterminated the once numerous rufus or South Pacific fur seal. German settlers developed a limited agriculture, finding a ready market for their vegetables to ships halting here to replenish fresh water supplies.

Population About 600

The population of the islands today totals about 600, most of whom live on Más a Tierra. Sections of this rocky island are quite fertile, and, as there is ample rainfall (125 to 150 inches a year), vegetables, peaches and grapes are raised. In addition to the half-wild pigs and goats, there are some sheep and oxen, the latter being used as beasts of burden. Fish is the staple of the local diet.

Most of the inhabitants of Más a Tierra are employed in two small fish and lobster canneries along Cumberland Bay, or in the catching of fish offshore. Since 1914 there has been a radio station. Later a meteorological station also was established.

Gunnera, a Unique Plant

While the islands have a milder winter than Valparaiso, and a more moderate summer, there are frequent sharp gales, and the humid climate in general is less agreeable. In south latitude the Juan Fernández lie about the same distance from the Equator as does Norfolk, Virginia, in north latitude. Some of the flora is unique. One large plant, the gunnera, has leaves ten feet in diameter.

A marine oddity of these waters is a fish that when alive looks like a swimming pine cone. When dead and dried the resemblance is amazing. Fairly common around the islands, this "pine cone" fish, of the genus *Monocentris,* has an isolated niche in oceanic life. It does not seem to be related to anything else. One genus carries lanterns, that is, luminous organs, on each side of the mouth, as do many deep sea fishes.

What about the future of these outposts of civilization? Obviously the principal income of Juan Fernández will always come from the sea. Its meteorological station should be increasingly important as more data is required for long range weather forecasting.

Before Juan Fernández can make the fullest use of its bountiful fisheries resources, however, more hydrographic and biological research is in order. In fact, the assignment of a well-equipped oceanographic research vessel, which would conduct concentrated studies in this little-known area, would be fully justified.

Such research might be combined with biological research in the vicinity of the port of Valparaiso, and extended studies of the mysterious Humboldt Current between the islands and Valparaiso. My own work convinces me that only a tiny corner of the vast biological southeast Pacific has been scratched. Future possibilities are challenging. If all goes well, we hope to meet some of these challenges during other visits to the southeast Pacific in the not too distant future.

Fish Library In Washington

For more than one hundred years the National Museum of the Smithsonian Institution, in Washington, D.C., has been collecting species of fish until now its "fish library" contains about 15,000 different kinds or species, distributed among more than 1,600,000 specimens. They are preserved in 170,000 containers which rest on basement shelves that—if laid end to end—would stretch out a distance of 3½ miles. Included in the collection are 6,000 "fish types." Each type serves as the basis of identification of a species. Where doubt exists as to how a certain kind of fish should be classified, the type must be studied carefully.

TYPICAL BARNACLE FOULING *on the bottom and propellor of a cabin cruiser hauled in from Biscayne Bay, Miami. This amount of encrustation is typical for a period of about two months exposure in this area. (T. W. McCuiston)*

Why Shipbottom Paints Fail

By SIGMUND MILLER

The Marine Laboratory, University of Miami

A BOAT OWNER WILL frequently ask, "Why doesn't antifouling paint work on my boat?" He has seen inexpensive paints give adequate protection to other hulls but the bottom of his own boat has rapidly become covered with barnacles, in spite of an expensive and highly recommended paint. This and similar questions are asked by people who are baffled by the apparent discrepancies between advertising claims and actual results. What does the scientist have to say about the mystery?

Damage Due to Fouling

The answer is of great importance to shipowners, yachtsmen, the Navy, and marine industry in general. When a ship remains at its moorings for considerable periods, marine plants and animals may attach to the hull at a rate as high as one pound per square foot per month. This alters speed, sailing characteristics, fuel consumption and even appearance as this rough surface is dragged through the water. Saltwater pipes on shipboard, and the intake systems of shore electric power stations, may become clogged also by such growths of barnacles or mussels.

Submerged metal structures, painted to withstand corrosion, often lose their protective coating when the growing shells of attached barnacles pierce the paint surface and expose the metal. Seaplanes have grown enough marine fouling on their hulls during two weeks to prevent take-off. Fouling has even interfered with the mechanism of mines and other devices of submarine warfare.

Good Paints Badly Applied

The tendency of boats to foul or not to foul is governed by many factors, the most important of which are the kinds and numbers of fouling organisms in the water, the type of service for which the boat is used, and the efficiency of the paints used to prevent fouling attachment. Some of the factors which control the intensity of fouling in any given area and the variations due to the nature of a ship's operation were discussed in "A Clean Hull and a Fast One" (Vol. 1, No. 3 of this magazine). But there are other ways in which the apparent efficiency of a bottom paint may vary, due to the way in which the paint is applied or the hull prepared.

There is only one device which can be used generally to protect the hull and that is the antifouling paint. Experiments are being carried out with mechanical devices, ultrasonics, air bubbles, etc., with some measure of success, but there is little possibility that they will come into general use in the near future. In order to explain the apparent vagaries of ship-bottom paints it is necessary to understand how they are made and how they work.

What's in the Paint?

The active ingredient of an antifouling paint is usually finely-ground metallic copper, cuprous oxide, or some other chemical compound of copper or mercury, or both. Experience and research has shown that these materials are almost universally poisonous to fouling organisms. The finely divided poison or toxic is compounded into a binder or "vehicle," which cements the particles together and to the surface to be coated.

Various other materials are added to develop individual desirable properties, such as color, hardness, shelf storage life, and so on. These insure that it will be a good *paint* as well as good for antifouling, that is, it will provide a good appearance, surface and protection to the wood against abrasion.

The toxic will not stop fouling unless it is in solution. If it all remains in the paint, fouling will occur. For this reason the nucleus of the paint—

that is, the cemented mixture of toxic and binder—is designed to dissolve at a predetermined rate when immersed in the sea. A thin layer of water adjacent to the paint film surface dissolves the toxic at a sufficient rate to kill fouling or discourage its attachment. This characteristic of *deliberate deterioration* distinguishes antifouling coatings from ordinary paints, in which durability of the paint film is generally the primary consideration.

Science Joins the Fight

Until only a few decades ago, the compounding of antifouling paints was more art than science. Then, during World War II, several nations supported extensive studies that revealed the principles upon which are based the techniques of present-day antifouling paint formulation. Paints are now available which, if properly used, can keep a ship free of fouling for years. Development of such coatings entailed years of careful experimentation and testing under the same adverse conditions likely to be met in service.

Regardless of how much care goes into its design, however, no antifouling paint can be expected to function satisfactorily when used improperly. Undoubtedly some antifouling paints are incapable of affording good protection in *every* locality. With knowledge of the various causes of failure, anyone can acquire the skills necessary to decide if a fouled bottom is the result of use of a poor coating, or abusive treatment of a good coating.

HOW SCIENCE SCREEN-TESTS *anti-fouling preparations. Panels in a frame, left, are immersed in the sea in an area of heavy fouling. They are carefully inspected each month, as shown here at the Frue Testing Station, Miami Beach, Florida. (Florida Photo Inc.)*

READ THE LABEL ON THE CAN. *Many good brands of paint are on the market, and it really is wise to buy the best. A high grade paint doesn't* cost, *it* pays. *But even the best paint may give poor performance if improperly applied. So read the manufacturers' instructions. (Sigmund Miller)*

Mistreatment of antifouling paints often occurs, even before the can of paint is opened. The label on the can usually gives directions for preparation of the hull surface before painting, but the label is never large enough to allow detailed instructions.

Good Painting Surface Essential

Sanding or chipping on the underside of a drydocked vessel is an unpleasant job, and the work is often hurried because days in drydock are counted as money lost. But surface preparation is as important a step as any in antifouling protection. A properly prepared surface can mean an extended period between lay-ups, with saving in maintenance costs.

When bare wood or sandblasted steel is to be painted, the manufacturer's directions are usually adequate. Wood should be sanded smooth and brushed or wiped to remove sanding dust. Some manufacturers recommend a priming coat of red lead or thinned antifouling paint before applying the final antifouling paint coats, but most paints may be applied directly to bare wood without priming.

Steel Hulls Need Primer

The most reliable procedure for sandblasted steel is to follow the sandblasting immediately with application of a wash primer. This material, which is essentially a mixture of phos-

phoric acid and a thinned primer, prevents the steel from rusting during the period between sandblasting and painting. It also provides a strong chemical bond between the steel and the first coat of paint. The wash primer is followed by a coating of anticorrosive primer of sufficient thickness to electrically insulate the antifouling paint from the steel. The colors of the wash primer and the primer should contrast, so as to show up "holidays" or thin spots in the primer coat.

Special Problems

At boat shows throughout the nation, an increasing number of pleasure boats with hulls of aluminum, glass-reinforced plastic and galvanized or zinc-sprayed steel are displayed. These materials exhibit marked advantage over wood and steel in so far as resistance to the chemical action of sea water is concerned. Rumors credit some of the new materials with having "built-in" antifouling protection. This is not the case. Fouling can be prevented from attaching to these materials only by application of an antifouling paint, and each type of hull requires its own special treatment in application.

Aluminum and its alloys, and zinc, which is the coating on galvanized steel, will deteriorate at a rapid rate if directly coated with antifouling paints containing copper in any form. When copper-based paint contacts aluminum or zinc in sea water, a galvanic (electric) cell is formed, and

DISC-SANDING IS A "MUST" *on a steel hull. Here the fouling has already been scraped off, and disc sanding will remove loose paint, rust and scale, a regular pre-painting procedure at the Merrill-Stevens boat yard, on the Miami River, Miami. (Sigmund Miller)*

rapid corrosion of the metal results. Chemical products of corrosion, forming between the metal and the paint film, blister the paint, which peels and falls away. Even while the paint film is intact, reactions between the paint and the underlying metal interfere with the antifouling mechanism of the paint, and fouling may attach.

Antifouling protection can be given to aluminum by using the same system as with steel—wash primer and anticorrosive primer before application of the antifouling paint. For adequate insulation between the hull and the antifouling paint, two coats of anticorrosive primer are desirable.

Dangers to Zinc-Coated Hulls

Zinc-coated (galvanized) steel requires more careful treatment than any other hull surface. Almost *any* kind of paint applied to a new zinc surface will blister and peel because zinc reacts unfavorably with the oils and resins in paints. Zinc can be stabilized only by exposing it to an outdoor atmosphere for several months, or by etching the surface with one of several commercially available phosphate or chromate preparations. The former method is obviously impractical for boats, so the latter should be followed whenever a zinc-sprayed or galvanized steel hull is to be painted.

Fiberglass Hulls

The chromate or phosphate treatment should be carried out by a qualified boatyard and a minimum of two coats of anticorrosive primer should be used.

Glass-reinforced plastic requires special preparation because it presents such a smooth, non-porous surface to paint. A new plastic surface should be scored with a coarse abrasive on a disc sander. This helps to anchor the paint. The first coat of paint can then be either a fiberglass priming paint, thinned antifouling paint, or antifouling paint as it comes from the can, depending upon the paint manufacturer's recommendations. If a primer is used, the primer and antifouling paint should be the same brand, to insure compatibility.

Old Paint is a Frequent Offender

The type of surface which most often is to be painted, and which usually causes the most difficulty, is a coat of old paint over one of the surfaces previously mentioned. Many failures of good antifouling paints can be traced to injudicious application over an unsound film of old paint. The old paint continues to deteriorate even when coated over, and can cause the loss of the entire protective coating film. It is more economical in the long run to abide by the general rule that, if an old paint film does not appear to have as sound a surface as that of the hull bottom itself, it should be removed before repainting.

Painting the Bottom

If all precautions have been observed in surface preparation, actual painting of the bottom becomes a relatively simple task. Only four details need be observed:

1. Stir the paint sufficiently before use to suspend all of the toxic pigment, and stir it frequently while painting.

2. Do not attempt to "improve" the paint by adding creosote, kero-

FINALLY COMES THE PAINT. *This clean hull and rudder, at Santana Marine Service, Miami, Florida, is the result of several hours of careful defouling and scrubbing down. It can now take a smooth coating that will resist all marine growth. (Sigmund Miller)*

sene, gasoline, or any other foreign materials.

3. Thin the paint only if it is absolutely necessary, and then follow the label directions carefully.

4. Apply the paint as uniformly as possible. One coat is usually adequate when repainting an old surface. However, some paints are so heavily loaded with toxic pigment that as little as

one-fourth of the film needed for adequate protection can hide the underlying surface. For this reason, two coats should always be applied to newly prepared surfaces to insure complete coverage and adequate thickness.

Waterline Failure

When a boat with a properly painted bottom is launched, several pitfalls still await even the best paints. Some practices which are thought of as a part of normal service can completely destroy the paint's antifouling mechanism.

The causes of interference can be grouped into two classes: mechanical and electrochemical. Antifouling paints can be inactivated mechanically by accidentally coating the paint with an impervious film of some foreign material, thus preventing the paint from releasing its toxic to the water. This might occur as a result of tossing a partially filled can of paint or varnish overboard while the boat is moored. Several inches of paint near the waterline then become coated with waterproof oil or resin film, and fouling is able to attach without hindrance.

Drydocking May Cause Failures

Even though the oil film is only a temporary condition, the fouling which settles is able to establish itself quite firmly before the antifouling paint resumes its leaching. The mature fouling organisms may then be killed by the antifouling toxic, but their attachment will remain firm.

"Suffocating" films can form over antifouling paints in other ways. The most subtle of these occurs when a boat is drydocked for a short period for minor repairs, then is launched without repainting or scrubbing the bottom. A slime film of microscopic marine organisms which forms on the paint while the boat is in service is ordinarily harmless. But it dries to form an insoluble, almost invisible film when the hull is taken out of the water. After launching, a long soaking period is required to soften this film sufficiently to permit the antifouling paint to resume its function. In the meantime, fouling can become established to the extent where it no longer is affected by the recovered paint.

Bottom Paint Can Become a "Battery"

Some paints "oxidize" and lose their effectiveness when subjected to atmospheric drying, but undoubtedly the slime film is also responsible for a number of similar failures. To take advantage of the oxidation resistance of top-quality paints, the boat bottom should be scoured with a stiff brush and an abrasive cleaner before relaunching.

Electrochemical inactivation of an antifouling paint can occur as a result of galvanic interaction between the paint and a metal fixture or fastening, or because of stray currents (electrolysis) resulting from faulty wiring. Every possible precaution should be taken to provide insulation between antifouling paint and metal parts (except brass, bronze or Monel) on wooden vessels.

This type of failure occurs over

bottom planking fastened with galvanized steel fastenings. If the fastening holes are improperly plugged and caulked, antifouling paint or dissolved copper can seep through to the fastening. This results not only in rapid corrosion of the fastening, but in the inactivation of the antifouling paint over a surface area several times the diameter of each fastening.

Electrical Grounds Important

If a vessel is improperly wired, electric current may be forced to travel through water as a result of its tendency to take the path of least resistance. If that path then happens to lead the current back to the boat through a coat of antifouling paint, the paint in the area will be inactive as long as current flows. If the current is strong enough, the paint film may be seriously damaged.

The same effect is produced when a vessel uses a shore current facility which is not properly grounded. In occurrences of this type it is not uncommon for the entire submerged side of a vessel nearest shore to become completely fouled, while the other side remains clean. The use of an isolation transformer between the vessel and the shore facility can prevent this.

Detective Work Required

Antifouling protection has always been thought of as a "black or white" proposition: inferior antifouling paints always foul; good antifouling paints never do. Such is not the case. Poor antifouling paints will remain clean if the boat is moored in fouling-free waters, and good paints may fail if improperly used. When a boat fouls

A CLEAN HULL IS A FAST HULL. *In order to be able to deliver the power and speed necessary to pull water skiers, it is important that small boat owners, too, use the best anti-fouling paints, particularly if they do not haul their craft out of salt water after each cruise. (Johnson Motors)*

it is desirable to first establish whether or not the paint itself was defective. This fact cannot be established on the basis of a single test on a boat because so many variable conditions prevail, so a bit of detective work is required.

If the aid of the boatyard is enlisted, it may be possible to locate several boats painted at about the same time with paint made in the same batch as the one in question. If the paint on all of these boats has records of good antifouling performance, then the paint is undoubtedly a good one, and improper usage is, in all probability, the reason for the failure. If some of the other boats have poor antifouling records, then either the brand of paint is inferior, or a particular batch of paint was defective.

When a good paint has failed, evidence of the cause can usually be found by careful inspection of the fouled bottom. The distribution of fouling on the hull and the condition of the remaining paint film will almost always provide clues to the reason for failure. If fouling is found only in the vicinity of metal fittings, for example, the trouble can usually be traced to improper insulation of the paint from zinc or magnesium anodes. If the paint has chipped or peeled, improper surface preparation or application may have been the cause. Close inspection of easily removed chips of paint will help to pinpoint the cause.

If one is familiar with the various factors which *cause* good paints to fail, the clues become self-evident. If the factors are kept in mind when the boat bottom is repainted, and the rules are carefully observed, these clues lose all importance because failure of *good* bottom-paint then becomes a thing of the past.

Seaweed Symposium

TO MOST seaside municipalities and owners of shore properties, seaweed is a nuisance that must be swept or raked up and carted away. But at University College, Galway, on the west coast of Ireland, it will be the subject of a special symposium, August 13-19, 1958.

At this third International Seaweed Symposium original contributions to biological, chemical and industrial knowledge of seaweeds will be presented. Three days will be devoted to shore-collecting and sightseeing. Among the shores to be visited are: Miltown Malbay, Aran Islands, and the Clare Island survey area. Intertidal ecology will be discussed August 19.

An exhibition devoted to the technology and commercial products of seaweeds will be held in conjunction with the Symposium, and marine firms are invited to exhibit. Queries should be addressed to the Secretariat, University College, Galway, Ireland.

AN UNFRIENDLY CUSS IS THE FIDDLER CRAB, *although he generally scurries away unless cornered. Two species are being studied at Sapelo Island laboratory to learn their preferences for various types of marsh, and their role in the overall economy of the Georgia tidal estuaries.*

Estuary and Marsh

By FRED J. DICKSON

THE GREATER NUMBER of marine stations are concerned with the oceans, the shallow areas, or the shores. Some, however, are engaged in the study of life in the tidal estuaries and marshes where rapid changes in the temperature and saltness of the water impose specialized conditions on the life which it contains. One of the most recent additions to the list of marine stations primarily concerned with estuaries is in the state of Georgia on the east coast of the United States.

On beautiful Sapelo Island, about five miles off the coast of Georgia, is the Marine Biology Laboratory of the University of Georgia. Financed by Richard J. Reynolds, Jr., island owner, it is located in a large tile and stucco building. Five individual laboratories, three constant temperature rooms and one larger room equipped with running seawater have been constructed in one wing of the building.

Laboratory equipment includes such things as microscopes, spectrophotometer, colorimeter, balances, autoclave, drying oven, high temperature furnace, constant temperature water bath, bacteriological incubator and other specialized items. For field

work several boats are available, including a 65-foot diesel vessel, a 22-foot motor launch and several outboard motor boats.

Now staffed by three full time resident scientists and two graduate students, University of Georgia scientists and visiting scientists also carry on research at the station.

Not Limited

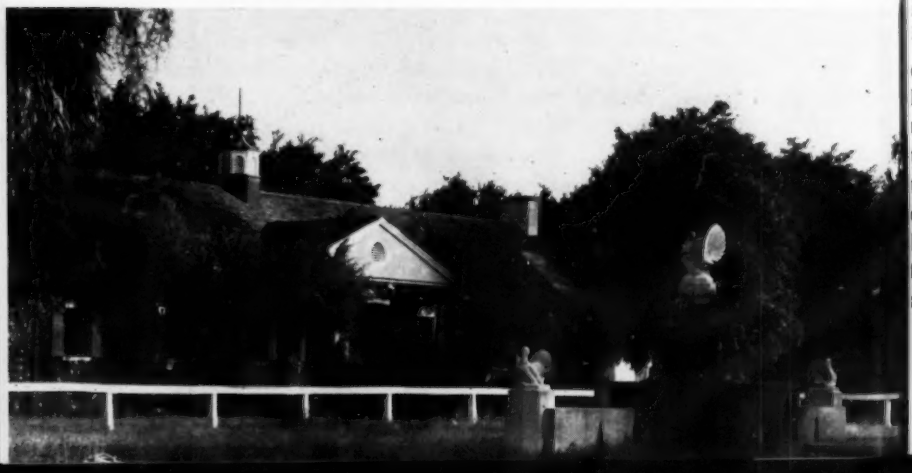
While basic research in marine biology is now the primary mission of the laboratory, investigations and studies are not limited to problems of this nature. The concept of biological productivity underlies much of the work. Within the broad subject of productivity, however, several projects deal with the production of organic matter by plants in the estuaries. The microscopic plants of the plankton, the algae, comprise an important group of such producers.

In the plankton is a large and important group of minute crustacea known as copepods. These tiny animals feed mainly on the algae, thereby forming the second link in the food chain which leads ultimately to larger sea life, such as fish and lobsters. One of the projects deals with the distribution and ecology of the copepods inasmuch as this subject has a definite bearing on sea and bay creatures of value.

Endless Marshes

The chemical substances that serve as food for the marine plants, the same as fertilizers feed and nourish land plants, long have been recognized as being vital to production processes. Phosphorus, nitrogen and iron are particularly important in this respect. Research to ascertain just how these substances are supplied to and held in the waters of the estuaries has just been initiated at the laboratory.

Along the Georgia coast are endless salt marshes, stretching farther than the eye can see. On these marshes a marsh grass grows thickly. This grass, *Spartina alterniflora*, is



FORMERLY A DAIRY BARN *on the Richard J. Reynolds, Jr., estate, Sapelo Island, the University of Georgia Marine Biology Laboratory makes an imposing appearance with its ornate fountain decorated by stone turkeys. The dormitory has quarters for visiting scientists carrying on research at the station.*

A SMALL MOTOR LAUNCH *is an ideal vessel for conducting research in the shallow marshes and estuaries that envelop Sapelo Island. In addition to marine fauna, scientists at the station are also studying the chemical substances that serve as food for marine plants.*

eaten directly by very few animals. Fiddler crabs pick their food from the mud surface, mussels pump water through themselves at high tide extracting the food they can use and discarding the rest, snails travel slowly up and down the marsh grass feeding upon the film of mud and algae deposited and growing there. Only the salt marsh grasshopper and the salt marsh leafhopper eat the grass in any large quantity. Apparently the grass must be decomposed by bacteria in the surrounding waters before it can be used as a food by the tiny salt water creatures.

On the surface of the mud in and near the marshes live many micro-

UNIVERSITY OF GEORGIA *Marine Biological Laboratory is beautifully situated on Sapelo Island, about five miles off the mainland. In addition to a well equipped laboratory and dormitories (above) boats are available for field work.*

scopic algae, or sea plants. These also contribute to the primary productivity of the area. This long neglected source of production is now under investigation at Sapelo Island.

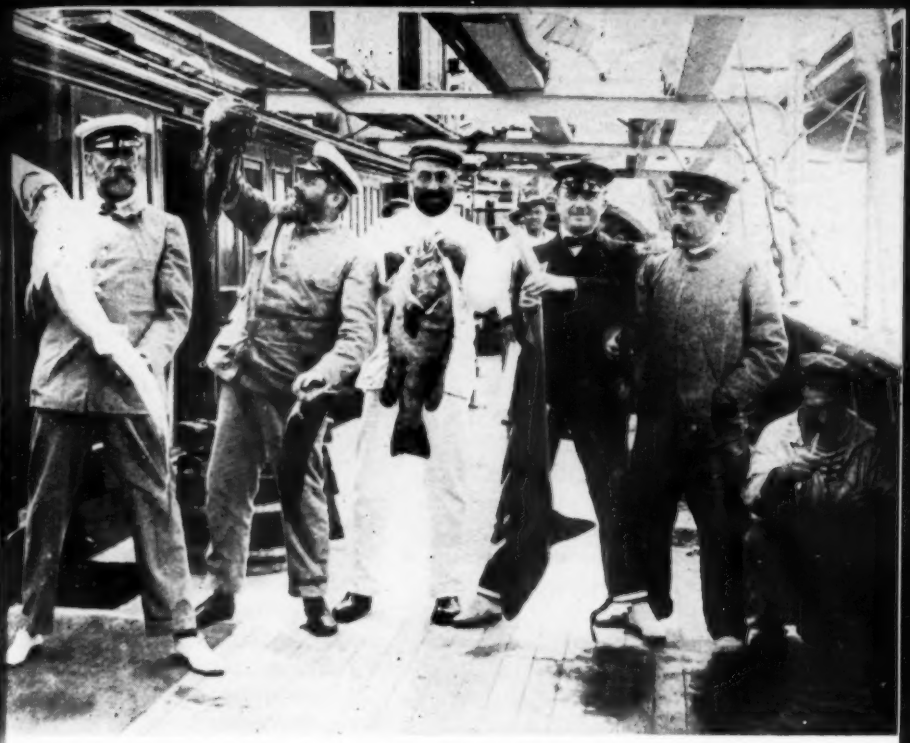
Fiddler crabs, extremely abundant in the marshes, scurry around grazing upon these minute forms of plant life. Two species of fiddler crabs are being studied in detail to ascertain their preferences for various types of marsh and their role in the overall economy of these areas.

Due to the shallow depth of the water and the large tidal sweep of the region, the water generally is quite muddy. Some of the material responsible for this condition is organic in nature. This material poses many problems to the biologist who seeks to learn where these organics originate, what role they play in the biology and microbiology of the area, and if part of it eventually is deposited as permanent sediments. The answers to these and other questions are being sought through another project underway at the laboratory.

Vitamin B12 Produced

There are a great many species of bacteria capable of attacking and decomposing dead marsh grass. Also, it has been found that vitamin B_{12} is produced in or near the marsh muds, perhaps by the bacteria.

Other projects having less direct bearing on the productivity of the marine plants and animals have been carried on at the laboratory. Likewise, a taxonomic survey of the land plants at Sapelo Island is now nearing completion. In addition, the large laboratory vessel, *Kit Jones*, was loaned to a group of scientists a year ago to carry out geological exploration of the subterranean rock strata underlying the waters of the Georgia coast, by seismic methods.



EVEN A PRINCE IS ENTITLED *to a bit of persiflage on a long sea voyage. Prince Albert (left) and some of the scientists and staff who accompanied him on an oceanic research cruise whimsically display their catches for the benefit of the photographer. (Musée Océanographique de Monaco)*

Prince of Oceanography

By GILBERT L. AND NANCY A. VOSS

FEW VISITORS to the Oceanographic Museum at Monaco, the famous little principality on the south coast of France, pause more than a moment or two to look at a statue of a man in a plain seaman's uniform, standing at the rail of his bridge, looking out with unseeing eyes over an imaginary ocean.

Yet this man, His Serene Highness Prince Albert Honore Charles of the House of Grimaldi, sovereign ruler of Monaco, was one of the world's most noted oceanographers and devoted a lifetime and a fortune to investigation of the sea.

Numerous kings, princes and nobles have been patrons of the sciences or have contributed to man's knowledge of the world, but none have risen

to such heights as the Prince of Monaco or made such lasting personal contributions.

Thorough Basic Training

Although we know almost nothing of his early life, other than that he was born in 1845, he undoubtedly was raised along the shores of the blue Mediterranean. When still only a youth, he entered the Spanish Navy and served in the ships of that nation as a lieutenant. The training must have been thorough and the life to the liking of the young man for he often spoke in later years of his navy life and, when he left the service, was an accomplished navigator and seaman, well able to take command of his own ships.

From the time he left the Spanish navy until 1885, the Prince's life was occupied in the study of oceanography and marine biology, and in formulating sweeping plans for the work ahead. The Prince saw things on a grander scale than most of his contemporaries and his interest was aroused by the many expeditions then setting forth to delve the depths of the sea.

Perhaps it all crystallized when, in January 1873, while on one of his early expeditions, his little yacht lay moored to the famous *Challenger* (a sketch of which tops the masthead of *Sea Frontiers*) in the River Tagus.

Hemp Rope for Sounding

His chosen field of investigation was the North Atlantic and he carefully charted his field work to cover the fullest scope possible. On July 9, 1885, he sailed from Lorient, France. His vessel, the *Hirondelle,* was a little schooner of 200 tons, manned by a crew of fourteen. She was loaded with coils of hemp rope for sounding and dredging, a deep-sea trawl similar to that employed by Alexander Agassiz aboard the *Blake,* a variety of sounding leads, and floats of different sizes and construction.

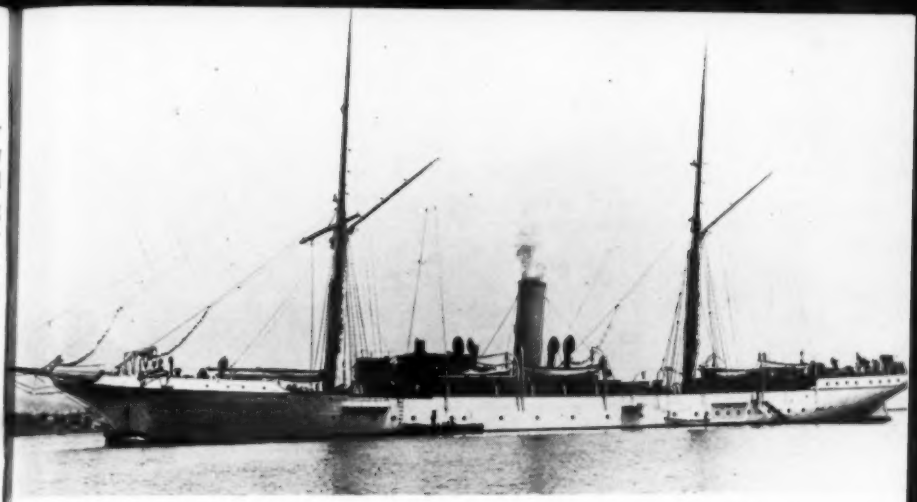
Floats Dropped

On the 30th, the expedition arrived at Fayal, in the Azores, and on the 27th of August it was 110 miles northwest of Corvo. Here, for two days they dropped the floats over the side, each destined, the Prince hoped, to be picked up around the shores of the North Atlantic as part of a long range plan to chart the circulation of oceanic surface waters. After many trawl and dredge hauls the cruise terminated at Lorient, August 31, 1885.

From 1885 until 1889, he made four long cruises in the *Hirondelle* taking him as far as the American coasts, and he explored the ocean depths to 1600 fathoms. His gear was "furnished with no other power," the Prince stated, "than the arms of my fourteen sailors."

Floating Laboratories

In 1892, the faithful little *Hirondelle,* having been worn out by storms and thousands of sea miles under her keel, was replaced by the *Princesse* dynamo, a freezing machine, water *Alice,* 560 tons, equipped with a large still, power winches, an automatic sounding machine, reels, trawls, and three well-equipped laboratories. Between the years 1892 and 1897, the *Princesse Alice* made four cruises,



LAST AND LARGEST *of several oceanic research vessels operated by the Prince was the* Hirondelle II, *commissioned in 1911. By the time of his death, in 1922, he had completed twenty-seven sea voyages, all of them yielding important scientific data. (Musée Océanographique de Monaco)*

covering chiefly the Mediterranean Sea and the Azores.

The work of this second period opened up exciting new fields of research, necessitating a still larger and more powerful vessel. The *Princesse Alice II,* an ocean-going steam vessel, of about 240 feet in length and 1420 tons, equipped with every type of instrument for investigating the sea, was commissioned in 1898. With this fine floating laboratory the Prince made twelve cruises, of which two were into the polar waters around Spitzbergen.

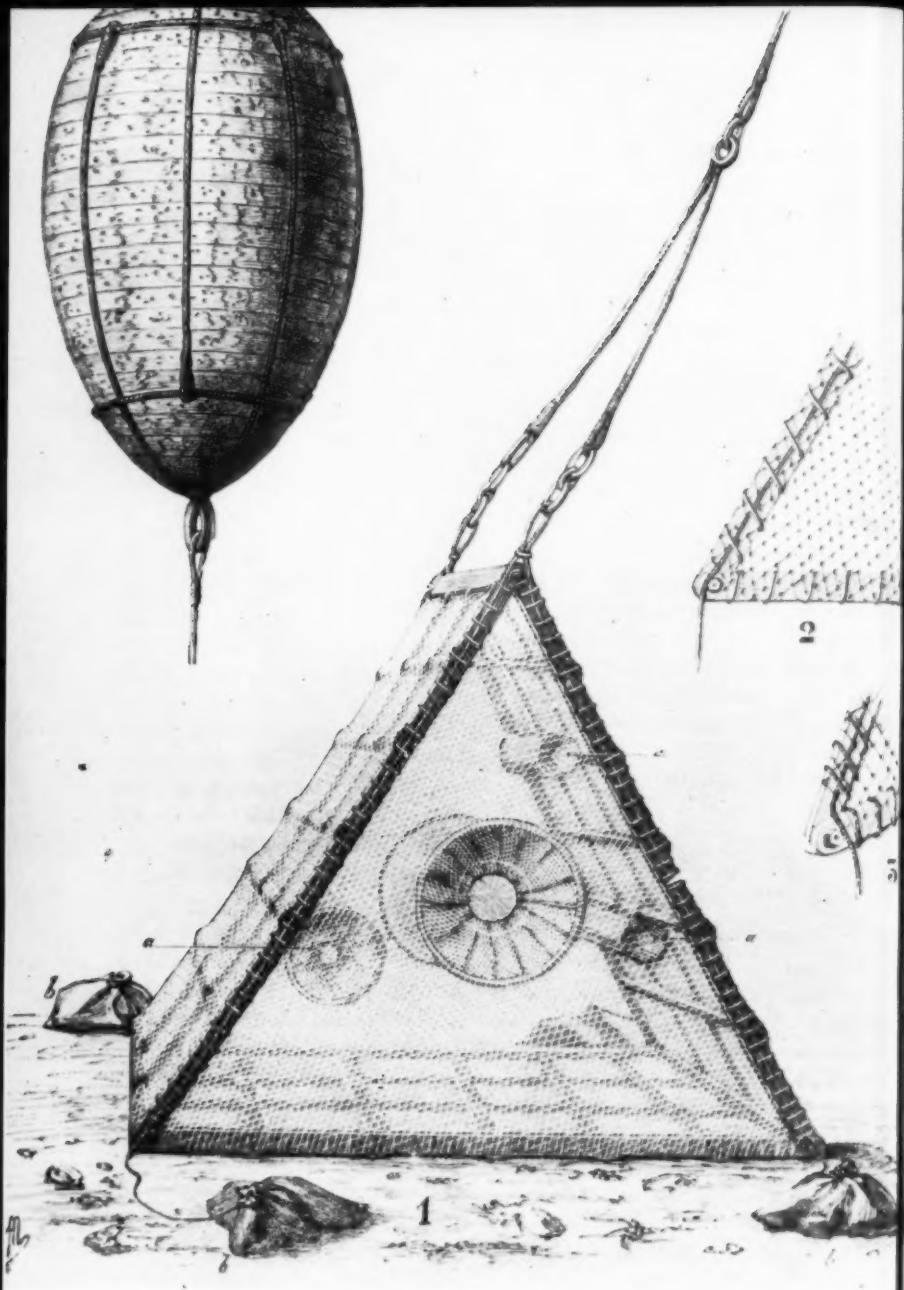
Total of 27 Voyages!

In 1911 his last and largest ship, the *Hirondelle II,* was commissioned. Between that year and 1914 four cruises were made, covering most of the North Atlantic and the Mediterranean Sea. By the time of his death, in 1922, the Prince had completed twenty-seven voyages.

Before studying the creatures of the depths, the Prince considered it necessary first to study the environmental conditions in which they lived. Consequently he began by investigating the surface currents of the North Atlantic, which through distribution of temperature and saltness play an important role in the range of animal species.

At first alone, and then in collaboration with Professor Pouchet, he observed ocean currents through floats, an oceanographic device he made famous. During the years 1885, 1886, and 1887, he launched on the North Atlantic three series of floats so constructed and weighted as to follow the flow of the surface water without being influenced directly by the wind.

In 1885 these floats were copper spheres, wooden barrels and ordinary bottles. In 1886 well-corked glass bottles were used, and in the following year strong glass floats with copper coverings were used. All con-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E OF LARGE TRAPS *for catching deep creatures was a particular innovation the Prince and one of the most successful. This fine drawing, from one of reports, shows details of the trap as ll as anchors and float. ("Resultats de mpagnes Scientifiques, 1931." Reinted with permission)*

tained a printed paper in several languages, enclosed in a sealed glass tube. It asked the finder to return the paper, together with the place and date of its recovery.

276 Floats Recovered

The first series, consisting of 169 floats, was launched over a distance of 170 miles and to the northwest of the Azores; the second series, 510 floats, over a distance of 500 miles along the 20th meridian west of Paris, and between Spain and England; and the third series, 931 floats, over 710 miles, extending across the Gulf Stream between the Western Azores and the banks of Newfoundland. By 1892, 226 out of the 1610 floats had been recovered; returns came from almost all of the countries on the shores of the North Atlantic.

Thus he calculated the probable course followed by each float. The dates on which they were launched were compared with the dates of their recovery, and the dates of the successive findings on all of the coasts were tabulated. He was thus able to establish the fact that the influence of the Gulf Stream, together with the influence of the prevailing winds, evaporation over large areas, density distribution, and the meeting of the warm waters of the Gulf Stream with colder ones such as the Labrador Current, combined to produce a vast whirlpool rotating clockwise, sweeping almost the whole North Atlantic. His observations gave valuable indications also of the speed of the different sections of this vortex.

Some Typical Findings

A comparison of the times taken by batches of floats from the same point of origin to their various ends enabled him to establish the following average rates for the twenty-four hours: between the Azores, France, Portugal and the Canaries, 5.18 miles per 24 hours; from the Canaries to the Antilles, to the Bahamas and as far as the Bermudas, 10.11 miles per 24 hours; and from the Bermudas to the Azores, 6.42 miles per 24 hours; the mean speed for the North Atlantic being 4.48 miles per 24 hours.

Because of the probable time lapse between the landing and the finding of the floats, these values were considered to be lower than the actual ones. The results of his work were read at the meeting of the British Association, 1892, by the Prince and the new chart was published in *The Scottish Geographical Magazine*, October, 1892.

After the movement of the surface water, the Prince sought to study the depths of the ocean and the resultant pressures. To obtain accurate measurements of depths, the Prince on his earlier cruises used the usual deep-sea lead on a stout hemp line. In his later investigations, he used steel wire and finally small steel cables which gave strength, pliability and safety. In 1891, he invented a machine for sounding. It braked automatically and

worked through springs, so that the winding of the cable and the regulation of the speed could be easily handled by one man.

The Famous "Monaco Chart"

Soundings were taken on all of his cruises. The Prince published at Monaco a "Carte Generale Bathymetrique des Oceans," on which are collected all of the accurate deep-water soundings of expeditions of all nations. Shortly before his death he appointed a commission of experts to revise this chart and issue a new and improved edition of the "Monaco Chart," as it is familiarly known today.

At the great depths of the ocean, the Prince found pressures compared to which the atmospheric pressure at the surface is trivial. He calculated that marine creatures are subjected to a pressure of about 15 pounds per square inch for every 5½ fathoms of depths, and concluded that the tissues of deep-sea animals must have a special structure to enable their organs to be functional under such conditions.

Temperatures of the Depths

At different depths the temperature of the water was found to change more or less regularly according to laws which were not fully ascertained. In the neighborhood of the Azores, readings were observed at 547 fathoms of 50.0°F down to 38.5°F at 3007 fathoms. To obtain these temperatures the Prince used the Chabaud thermometer, a modification of the Negretti and Zambra thermometer, designed for the Prince by M. Chabaud, a French instrument maker. This is very similar to the present day reversing thermometer.

In the summer of 1902, the bottom water at 800 fathoms, just outside of the mouth of the Mediterranean, was found to have the very high temperature of 48.9F. But the temperature of the bottom water of that region was not known to be higher than 40.1F.

It was concluded therefore that they had found one of the main overflow drains from the deep regions within the Mediterranean where the bottom water is much warmer than the Atlantic bottom water. This is due to the sinking of warm surface water which, as a result of excess evaporation, is made heavier. By comparisons of water temperatures it was calculated that at the point outside the Mediterranean the water was derived roughly 50 per cent from the Atlantic and 50 per cent from the Mediterranean.

Four Gases in Sea Water

The Prince next found it necessary to study the composition of sea water in relation to marine life. For this he used the water bottle, or sampler, devised by Mr. Buchanan. With it he took innumerable samples over the course of the North Atlantic.

Sea water was found to contain four gases—oxygen, nitrogen, carbon dioxide and argon. The proportions in which these gases were present varied greatly. After researches made on the second voyage of the *Princesse Alice* in 1895, Dr. Richard, the chief of his laboratory on board, was the first to announce the presence of argon in the swim-bladder of certain deep-sea fishes.

One of the chief contributions

made by the Prince to the science of oceanography was the development of numerous marine instruments or modifications and improvements of existing types. In studying the penetration of light in the ocean, he used a photometrograph invented by his friend Dr. Regnard, which showed how rapidly light decreases in intensity below the surface. He also improved the Buchanan sounder, used to collect samples of bottom oozes and muds.

Meteorological Station Needs

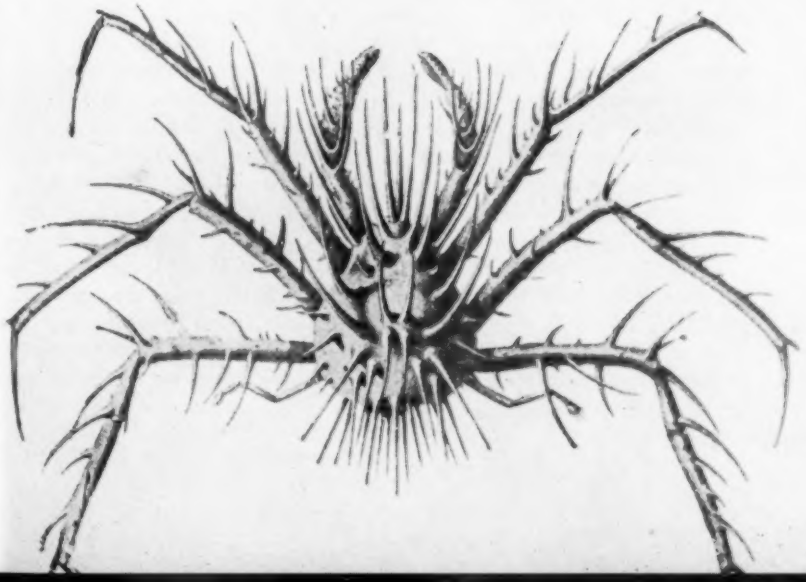
The Prince brought before the British Association at Edinburgh a project which his scientific cruises had suggested and preliminary experiments had matured — the establishment of oceanic meteorological observatories. He proposed the establishment of observation stations in certain favorable positions: Bermuda, the Azores, the Canaries, and the Cape Verde Islands.

In response, the Portuguese government created, on the island of São Miguel, a regular meteorological station in the same year and in 1897 established on the island of Flores, the most westerly of the Azores, a second station, the observations of which were useful for supplementings those of São Miguel. Studies made by these stations proved of inestimable value when trans-Atlantic air routes were later routed via the Azores.

In 1898, the Prince established an international meteorological commission of the maritime nations interested, with Portugal's representative as its chairman.

The Prince himself investigated the

PRINCE ALBERT USED FISHES AS COLLECTORS. *This rare crab,* Neolithodes grimaldii, *was obtained from the stomach of a tunny caught off Newfoundland banks.* (Resultats des Campagnes Scientifiques 1931. *Reprinted with permission*)



influence of the trade winds upon the surface circulation of the North Atlantic and especially of the counter-trade winds of the northern hemisphere. Hargrave kites sent to a height of 4500 meters furnished no indication of the existence of these counter-trades in the region explored, although their existence had often been reported by other observers.

Work With Balloons

After a year's work with kites in the Atlantic, the Prince decided in 1905 to use the system of *ballons-sonde* to study the atmosphere at great altitudes. Briefly, they consisted of two rubber balloons, differing in inflation, carrying the registering instrument and a float. The function of the more inflated balloon was to aid in the ascent of the system and to determine the height reached by bursting at a predetermined level.

On the seventh cruise of the *Princesse Alice II,* covering 3500 miles in the Atlantic, eighteen experiments were made with balloons rising up to 14,000 meters. Most of these were successful and confirmed the conclusions that the winds of the Canary Islands were not of the supposed counter-trades, but were of purely local cause. The Prince also used pilot balloons, which furnished valuable information regarding the direction and velocity of the high aerial currents.

High-speed Arctic Winds

On the following cruise of the *Princesse Alice II* in 1906 the Prince used pilot balloons, discovering that there exist in the Arctic regions, in the neighborhood of the 80th parallel, at about 13,600 meters, winds of 60 meters per second (132 miles per hour), a permanent force for which there is no equivalent on the surface of the globe. Their direction was S 68° W.

As a result of his oceanographical and meteorological observations, the Prince was better able to view the organic life of the ocean as a part of a single unified whole. He noted that the inhabitants of mid-ocean at certain levels alter their position at different times of the day, probably under the influence of the sun. He noted that the distribution of organisms was limited by variances of density, temperature, light and pressure. He used Haeckel's classification of marine animals, calling "plankton" all those freely moving between the surface and the bottom, and "benthos" those which live on the bottom.

Too Sociable Crabs

On the north coast of Spain, not far from the greatest depths of the Bay of Biscay, the trawl came up filled with crabs the size of mice, armed with very sharp claws. They were of the little known species, *Polybius henslowi,* and they had been taken in the intermediate regions as the trawl was coming up. By weighing a portion of this mass they determined that they had taken at least 5000 individuals. The crabs soon spread all over the yacht and for several days were found in every hiding place, even in shirt pockets and boots!

At another time, the trawl brought up, with a host of other organisms, a sea-urchin which looked so different from the others that the Prince picked it up for a closer examination. When

he did so, he received a prick from the spines which caused an excruciating pain lasting for several hours. It happened to be one of the poisonous deep sea echinoderms discovered by Alexander Agassiz aboard the *Blake*. Its sting is more powerful than that of the dread Portuguese man-of-war.

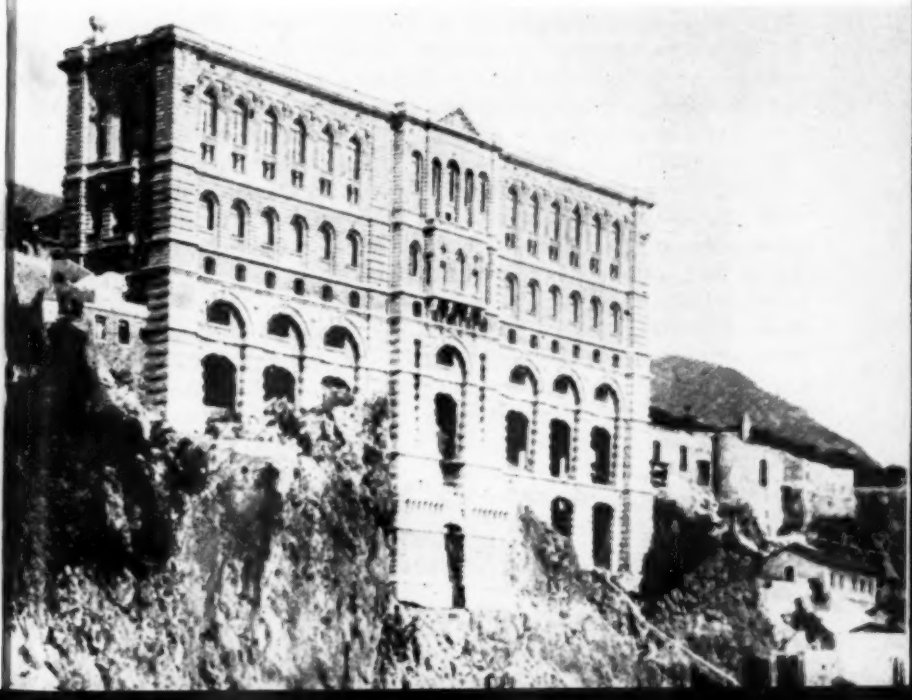
A startling discovery was a fish, *Grimaldichthys profundissimus,* which was taken from 6035 meters, and was at that time the deepest dwelling fish ever taken. Only since 1952 have any fish been taken below that depth, the deepest now known being a liparid taken by the Russians in 7200 meters of water.

In studying the fauna of the deep sea, the Prince employed every known type of net, some of gigantic size. Many of his experimental nets are only now coming into commercial use.

Unique Deep Sea Traps

But the use of tremendous traps for catching deep sea animals was a peculiar innovation of the Prince and one of the most successful. They brought up many new creatures which could be caught be no other means—large crustaceans, mollusks, and numerous fish. These traps were lowered to great depths and left for several days attached to a buoy. The tech-

SHEER FROM THE SEA *rises the Oceanographic Museum at Monaco. This world-famous institution is devoted to the history of oceanographical research and the collecting of early instruments used in the investigation of the sea.* (Founders of Oceanography and Their Work, *Edward Arnold & Co., London. Reprinted with permission)*



nique of handling such large traps was learned only after several years of experimentation.

Besides finding animals new to science, his traps enabled him to demonstrate the abundance of life in some parts of the great ocean floor. For example, in 1897 a trap at 700 fathoms to the southwest of the Azores brought up 1189 fishes, called *Simenchelus parasiticus,* and known previously from only two specimens in the collections of the world.

Again off the Azores another trap brought up sixty-four crabs of a new species, *Geryon affinis.* They were of enormous size and some which had not found the mouth of the trap actually made the trip to the surface voluntarily on the outside of the apparatus. In 1896, the Prince began using a trammel-net with great success. This type of net gave the best results along inshore fishing grounds.

Most Difficult Layer

The intermediate depths between the surface and the bottom of the sea were considered the most difficult to investigate because their inhabitants were undoubtedly good swimmers, very suspicious, and already provided with abundant food. By comparing hauls made at different times of the twenty-four hours with closing nets, he found that large populations of fishes, mollusks, annelids, medusae, cephalopods and crustaceans came to the surface at night and returned before day to a depth of hundreds of fathoms.

None of the Prince's expeditions were more novel or exciting than whale hunting in the Mediterranean Sea and the Atlantic. What his traps and nets could not catch, the Prince reasoned, whales could, so he hired an English harpooner, outfitted his vessel for whaling, and set out in search of these formidable denizens of the sea.

Whales as Collectors

Each whale killed was quickly brought alongside the mother ship and the stomach opened for examination of its contents. Nearly all of the stomachs contained animals either rare or new to science. Most of them were squid.

One of the most remarkable specimens obtained by such methods was the squid, *Lepidoteuthis grimaldii,* which belonged to no species, genus or family known at that time. It was vomited out by a sperm whale under the stern of the *Princesse Alice,* but had previously been decapitated. Fragments of another were recovered in the stomach of a grampus harpooned in the same region two years later, in 1897. From the original sperm whale another new species, *Cucioteuthis unguiculatus,* was obtained, and the 1897 expedition took a second specimen. One of his captured whales was reported to have contained a partially digested cephalopod arm or tentacle 24 feet in length.

"Lanterns of the Deep"

The Tunny fish, found widely distributed over the North Atlantic, and feeding on the fauna of the intermediate zone, similarly assisted in yielding numerous new fish, cephalopods, crustaceans and pelagic mollusks. *Halosauropsis macrochir,* a

deep water fish known before only from imperfect specimens, was taken off the Azores. It was described as carrying luminous organs on twenty-five scales along the lateral line—"real lanterns, of which the light can be hidden at will by means of an opaque black membrane."

Another new fish, *Photostomias guernei,* was obtained off the Azores, and a new crab, *Neolithodes grimaldii,* was obtained from the Newfoundland banks from the stomach of a tunny.

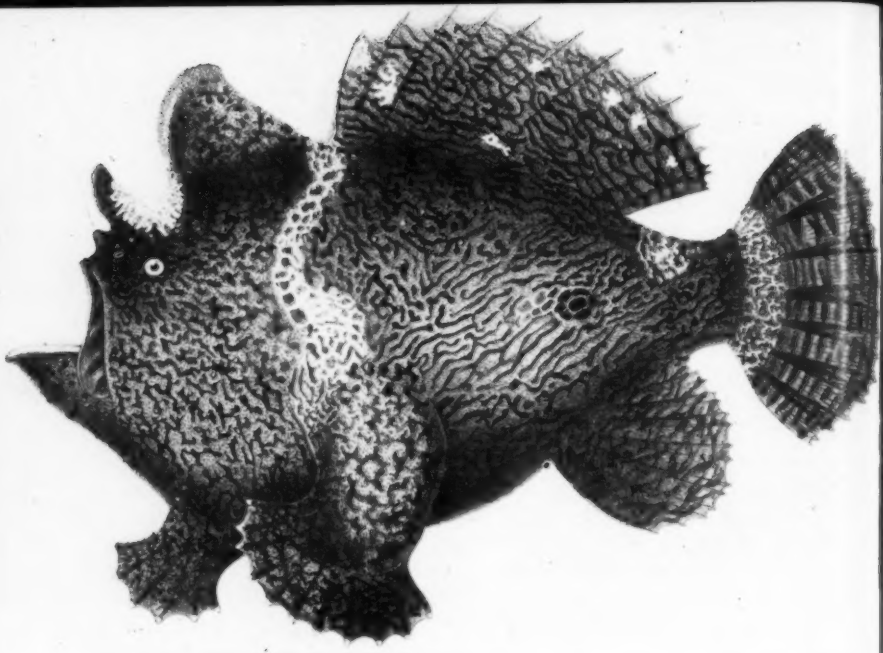
As the years advanced, the Prince sought to give more permanency to his studies. In 1906 he established at Paris the "Institut d'Oceanographie" with the chairs of physical oceanography, biological oceanography, and marine physiology.

Four years later he opened the world famous Musée Oceanographique de Monaco, which rises majestically above the sea on the rock of Monaco. It is devoted to the history of oceanographical research and early instruments for the investigation of the sea. A third contribution to science, but in another field, was the founding of the "Institut de Paleontologie Humaine" in Paris, devoted to the study of early history.

Three outstanding contributions made by the Prince have had lasting influence upon this field of science. Of primary importance was his insistence that major development of the field of oceanography could only be made through *international teamwork,* a fact which has only lately been recognized and is now exemplified in the International Geophysical Year. Another, with long lasting importance, was his conception of the line of meteorological stations in the North Atlantic and the use of weather ships far from land. The latter have proved their value many times over. Finally, his discovery of the "Jet stream" in the upper atmosphere has had great import in meteorology and high altitude flight.

PRINCE OF OCEANOGRAPHY. *A statue of the late sovereign of Monaco has a place of honor in the Oceanographic Museum he founded in 1910.*

World War I brought an abrupt end to the Prince's expeditions with the fourth cruise of the *Hirondelle II* in 1914. But the Prince remained active in scientific circles throughout the war and for the years immediately thereafter, serving as president at various conferences. His death in Paris, in June, 1922, was mourned throughout both the diplomatic and scientific worlds.



THIS FLAMBOYANT FELLOW *shows clearly the rather clumsy modification of pectoral fins (lower left) which makes them look a little like the legs of a frog.* Antennarius moluccensis *is his equally flamboyant name. (Smithsonian Institution)*

Almost Too Ugly For Words!

By E. JOHN LONG

WHILE THE AVERAGE person, quite understandably, may consider the frogfish almost too ugly for words, to the ichthyologist the finding of any members of the odd family *Antennariidae* is an event indeed, to be proclaimed proudly to fellow marine biologists and to the world in general.

One good excuse for such enthusiasm is that there are not too many frogfishes, although they are scattered throughout the tropic seas. And because no two frogfishes look quite alike (they can change colors like a chameleon to match the hue of the seaweed in which they lie in wait for their prey) they seem to have a strange effect upon even the experts.

Not Every Find a New Species

For instance, many seasoned marine biologists, who would regard any other encounter with a creature of the seas as a matter for calm and detached investigation, seem to go overboard for frogfishes, and would have us believe that every find is a new species, deserving a new name.

This, of course, cannot be. There actually is some variety among frogfishes, but not that much. It does seem high time that someone called a halt to promiscuous fish-naming, not only of frogfishes but other denizens of the depths as well.

Dr. Leonard P. Schultz, curator of fishes at the Smithsonian Institution, brings the matter rather sharply to the attention of fellow scientists in the introduction of a treatise on "Frogfishes of the Family Antennariidae," recently published by the Smithsonian in Washington.

World-Wide Study Needed

"I find it impossible to place confidence in the literature describing the marine reef fishes of the tropical Indo-Pacific regions unless the genus or the family in which they belong has been revised," he writes, adding, "Ichthyologists or fishery biologists who have not attempted a revision of a genus of widely ranging marine fishes cannot possibly assess the untrustworthiness of most current faunal lists.

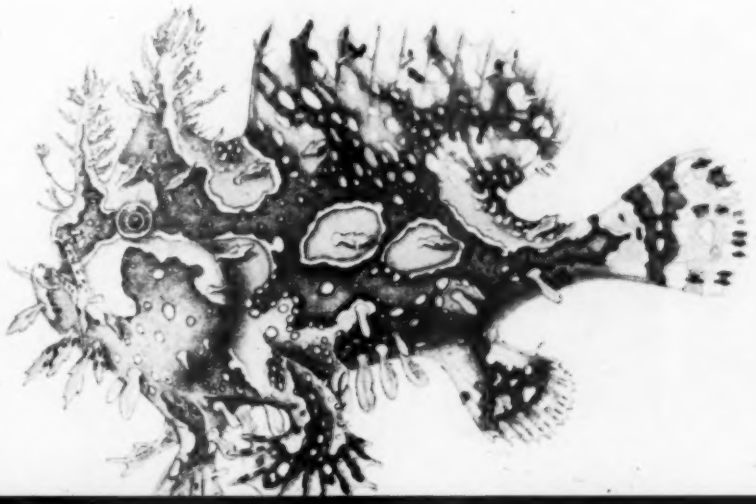
"To identify correctly as to genus and to species, tropical Indo-Pacific fishes must be considered on a world-wide basis. Those few individuals who have attempted revisions of genera have found a disturbing percentage of the scientific names correctly applied to be unreliable."

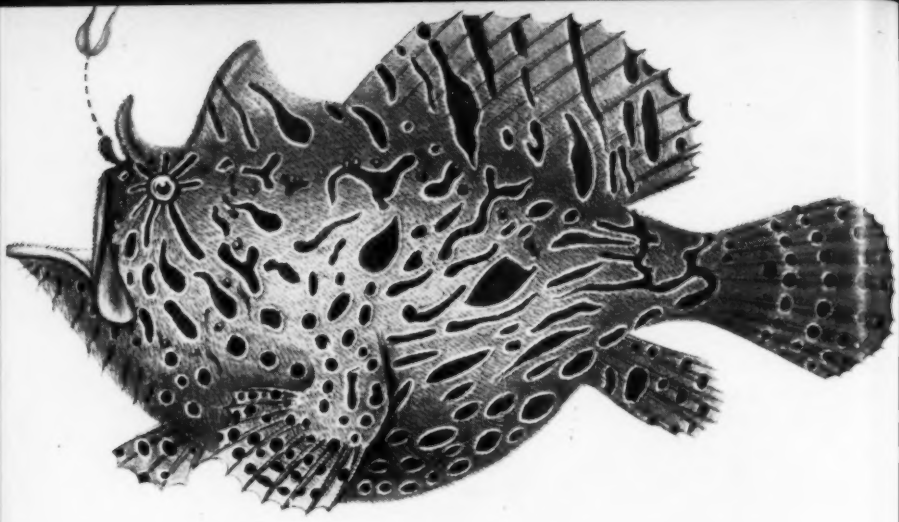
Not Related to Frogs!

With this off his chest, Dr. Schultz proceeds to give us the most complete and authoritative account of the family Antennariidae to date, including fourteen pages of illustrations showing 54 striking examples of the hideous little monsters.

First, in any consideration of the frogfish, we must dispose of the idea that it has any relationship to the frog. The common name derives apparently from a rather clumsy modification of its pectoral fins which makes them look a little like the legs

AS HIGHLY CAMOUFLAGED *as a World War I destroyer, the* Histrio histrio *can scarcely be distinguished from the weeds of the tropical sea, where motionless it awaits its prey. (Smithsonian Institution)*





A REAL FISHING FISH. *Note the pronged antenna of the* Phrynelox striatus, *resembling a pair of marine worms. These are dangled before passing fish, and, when they swim up for a nibble, the frogfish opens its cavernous mouth, quickly taking in the visitor by the sheer rush of water. Sometimes a fish as large as frogfish itself is engulfed. (Smithsonian Institution)*

DARK BROWN ZEBRALIKE STRIPES *and nearly naked areas distinguish* Phrynelox scaber *from the other little monsters of the frogfish family. Its long bifid tentacle, or built-in fishing rod, is also more conspicuous. Unlike its cousin above, which roams the tropical western Pacific and Indian oceans,* scaber *is a native of the western Atlantic Ocean. (Smithsonian Institution)*

of a frog. Its very large mouth may also have influenced the original naming.

One of the "Fishing Fishes"

Aside from its sheer ugliness, the frogfish is interesting for other reasons. It is one of the "fishing fishes," with a built-in fishing rod or antenna projecting from the end of its spine over the mouth. Its habits present also a curious combination of being carniverous, voracious, and very lazy.

Most frogfishes are content to lie motionless in the tropical sea shallows among the weeds. The end of its antenna is pronged, resembling a pair of marine worms. Some have variously decorated antenna tips. These are dangled before passing fish, and, when they swim up for a nibble, the frogfish opens its cavernous mouth, quickly taking in the visitor by the sheer rush of water. Sometimes a fish as large as the frogfish itself is engulfed.

Although the frogfish does not get about much, which may account for its rarity, the female puts out a prodigious quantity of eggs for her size. These are liberated in a single long ribbonlike mass, which before depositing lies closely packed within the fish "like a banknote tightly rolled up from its two ends."

Inflationary Phase

Another curious phase of the frogfish is its habit of inflating its stomach with water or air, which swells the creature to an enormous size, that is, several times the normal foot-length of the average frogfish. Whether this little trick is intended to scare off enemies or astonish friends of the frogfish has not yet been determined.

Can Natural Sponges Make Comeback?

SYNTHETIC SPONGES have almost replaced natural sponges in the public marts, largely because natural sponge blights in recent years severely restricted the supply. But natural sponges still have certain advantages over artificial sponges, particularly for bathroom use, and the American natural sponge resource could be restored to a high sustained-yield basis if proper management and harvesting practices were put into effect, the Department of the Interior has announced.

The statement was based upon a study just completed by the University of Miami Marine Laboratory under contract to the U.S. Fish and Wildlife Service. Briefly the study shows a high sustained-yield goal can be obtained if: (1) harvesting is restricted to sponges not less than six inches in diameter; (2) a program of transplanting mature sponges during the spawning period is conducted; and (3) certain other changes in management and harvesting techniques are inaugurated.

ONE OF THE AUTHORS, *Dr. Idyll, examines two strings of fish offered for sale in Amapala, on the south coast of Honduras, while studying the possibilities of expanding the fishing industry. A passing housewife shows an amused interest in the proceedings. (Marine Laboratory)*

Honduras—A Fisheries Potential

By C. P. IDYLL AND WILLIAM SAENZ
The Marine Laboratory, University of Miami

"I CAN BUY beefsteak at 50 centavos a pound in Tegucigalpa, but it costs me one lampira and 20 centavos for good fish. That's nearly two and a half times the price of beef," complains a furniture store owner in the capital of Honduras.

"This road is pretty bad now in the dry season, but you should see it in the wet season! It is very, *very* bad then!" is the lament of a cattle rancher, driving us to his *finca* near San Pedro Sula, second city of the country.

These statements help to explain why the people of Honduras, in Central America, consume only a quarter of a pound of fish per person each year, and why Honduras, with coasts on two oceans, is making so little use of its marine fish resources.

A fishing industry, it should be

noted, is more than fishing. In fact, the presence or absence of fish may be a minor factor compared to the problems of biological conservation, transportation, processing, engineering and marketing economics. That is why, at the University of Miami, we work as a team, bringing together experts in all these fields, when surveying a potential new fishery. This realistic approach is well illustrated by the challenge we found in Honduras.

Gap in Nutrition

The request for our visit came from Dr. Raphael Callejas, energetic chief of the Development Department of the National Development Bank. Could Honduras fill a part of the gap in their nutritional requirements with fish? Perhaps the extremely low per capita consumption could not be brought up to equal the 11 plus pounds in the United States, nor certainly to match the Japanese appetite for sea food (75 pounds per capita per year). But did it not seem logical that more use could be made of food that should readily be produced from 400 miles of coastline on the Caribbean and 40 miles on the Pacific?

This is an important question in a nation short of proteins. An affirmative answer could mean a great deal in terms of the general health of the Honduran people and in terms of wealth to the country.

Sixteen days are far too few to get all the answers to such a complex problem. We make no pretense of supplying final opinions on how much additional exploitation the fish stocks could stand, or what would be the best means of encouraging the Honduran people to eat more fish. Nonetheless it did not require acute observation to discover some factors holding back the development of the industry.

No True Fishing Industry

There is a difference also between mere *fishing* and a true *fishing industry*. Fishing is conducted along the whole of the considerable coastline of Honduras, but it is largely a matter of one man, or less often, two to six men, operating a small boat with primitive gear. There is virtually no commercial fishing with an organized system of catching, selling and distributing seafood. What little seafood commerce exists is mostly a matter of a fisherman selling a small quantity of his catch on the beach.

On the north coast of Honduras, fronting on the Caribbean Sea, some residents of Puerto Cortez, Tela, La Ceiba and Trujillo (these small towns were the locale of O. Henry's *Cabbages and Kings*) fish for a part of their living, but very few make their whole income from fishing. Fish are shipped to inland towns to a limited extent. For example, one of the very few railroads in Honduras runs from Puerto Cortez to San Pedro and to La Lima.

An Inland Fish Market

One day we watched these fish come in to San Pedro. The station was crowded and the fish peddlers—three or four of them—set up business not more than four feet from the door of the railroad car from which the fish emerged. They were neither iced nor gutted and were not sold by the pound but by the string—three

or four small fish, weighing around a quarter of a pound apiece, being hung on a knotted palm leaf. These strings cost 50 centavos each (or 25 cents in U. S. currency). The fish were lookdowns, small snook and mojarras. In a few cases fish of a reddish color were included — either snappers or rockfish — and in this case the price was higher, since red fish are highly regarded.

The fish were sold within minutes of the arrival of the train and it appeared as though more could have been disposed of easily. Fewer fish arrive on this midmorning train than on the one arriving earlier in the day. This first lot is sold through the streets of San Pedro by pushcart peddlers.

Columbus Stopped Here

On the Pacific side, two small companies send fish by truck from San Lorenzo to Tegucigalpa, the capital, but Amapala, the port on Tigre Island which once also supplied the capital city, has ceased to ship fish there.

These operations exhaust the domestic commercial fishery activities. There is only one fishery operating for export. This has been active at Guanaja (pronounced Wan-ah-ha), the colorful little island where Columbus first touched Central America on his fourth and final voyage. Here an American shrimp company has based its operation and, until its freezer vessel was wrecked on a reef, it produced shrimp and some fish, and shipped them to Florida. This company is attempting to get its operation going again with its remaining three vessels.

DIVIDING UP THE DAY'S CATCH. *Fish a unloaded into a big metal tub, ab which each fisherman gets a share. I how the larger fish in the background fits into the deal is not explained. (M rine Laboratory)*

A commercial fishery operation, involving handling, freezing and shipping of a commodity like shrimp, requires a considerable amount of space for docks, freezer, storage and similar purposes. Guanaja seems a very unlikely place to locate from that point of view. The island is tiny —perhaps five acres in extent, and every square foot of it is occupied. In fact it is *over-occupied,* because pressure of population has pushed many houses and other buildings out over the water, where they stand on stilts on the shallow white reefs surrounding the island. Boats move up and down the canals formed in this way. The town has, of course, come to be known as the "Venice of Honduras."

Two Isles Named "Guanaja"

The town of Guanaja, bursting its seams on this tiny key, is only a mile or so from a much bigger island, also called Guanaja. It seems very strange that the community should have developed where it did, rather than on the big island where living space was unlimited. The original settlers, who came from the British Cayman Islands, left their homes to escape insects, chiefly malarial mosquitoes. They decided, the story goes, that fewer insects lived on the little island

than on the big one, and they chose the site of their picturesque town accordingly.

One other unusual characteristic of Guanaja is that the inhabitants of the town speak English — a legacy from their Cayman ancestors.

The Cayman Islanders have been famous as fishermen and sailors, and this explains the location of the U.S.-owned shrimp operation, since the inhabitants of Guanaja have inherited their seamanship as well as their speech.

Fish Similar to Florida's

The kinds of fish in Honduras salt waters are much like those of Florida. Snappers and groupers predominate in the catches, the more so since hook and line gear is mainly employed. We saw a lot of jacks among the fish offered for sale, and many of the salted fish were of this variety. Croakers are fairly abundant and a considerable variety of rockfish or sea basses were seen, particularly among catches from the Bay Islands, off the north coast. One species of rockfish was very colorful, having a bright vermilion back.

Species caught in smaller quantities include Spanish mackerel, kingfish, tarpon (yes, they are eaten—mostly salted), barracuda, catfish, dolphin and sharks (they are eaten too).

On the Pacific side, in the Bay of Fonseca, weakfish, or sea trout, appear to be the commonest fish caught, while sharks, groupers, mullet and snook are numerous.

Two kinds of shrimp are taken commercially in the Caribbean, these

BECAUSE HONDURAS LACKS REFRIGERATION FACILITIES, *or even adequate supplies of ice for much of its sea fishing, some of the catch must be dried in the hot tropical sun. These racks stand on the shore of Tigre Island, Gulf of Fonseca. (Marine Laboratory)*

being pink and white shrimp. Seabobs also turn up in the markets of La Ceiba at certain times of the year, being caught near shore by cast net fishermen.

Crabs Are Shunned

Spiny lobsters occur in the Caribbean, but apparently in smaller quantities than in British Honduras, where a sizeable fishery exists for this species. Crabs, oddly enough, are almost ignored, and most of those caught are given away, apparently because crabs spoil easily. This has led to the idea, in Honduras as well as in many other places including the United States, that dead crabs (or lobsters) are poisonous. This is not so, but since a buyer usually does not know how long the animal has been out of the water, it is safer not to eat it, because the fast spoiling flesh may make him sick.

Another curious belief of a related kind—and this one we had not heard in the United States, or any place else—was told to us at Amapala, the fishing port on the Pacific. Here the tidal range is considerable (for the tropics) and fishing operations are greatly influenced by tides.

Stop nets and *chinqueros,* for example, depend on the tides. Stop nets are walls of netting strung across a bay, or along a shore line, at high tide. They intercept fish moving to deeper water as the tide recedes, and these stranded fish can be picked up out of pools which are left. *Chinqueros* work on the same principle, but they are permanent stone barricades which trap the fish as the tide goes out.

Fishermen believe that if the tide rises again and touches the fish that have been stranded by the stop nets or *chinqueros,* they spoil. This idea arises from the fact that fish left for any length of time in the mud in the temperatures prevailing in Honduras are spoiled, and certainly fish left over a tidal cycle would be in pretty bad shape.

Clam Shells Used In Walls

Clams are an important item of food in communities close to the Pacific Ocean. Two species of the big heavy-shelled clam area are eaten, and their thick valves litter the beaches and streets of Amapala and San Lorenzo. We saw them used as cobbles for paving walls. The larger of the two varieties is much scarcer than formerly, and people have turned to the smaller species.

Oysters also have declined—and little wonder! The natives have a quaint and appalling custom of "on-the-bed" cooking of oysters. At low tide they rake together a pile of oysters and light a fire on top of it. This partially cooks the oysters and forces them to gape, making opening and eating of meats simple. It also destroys the beds, and oysters are now scarce in many regions.

Resort Possibility At Tela

Sport fishing is good in Honduras—at least on the Caribbean side. The Caribbean beaches, with their white sand and graceful palms rival Florida's in beauty and it seems certain that vacation resorts, with fishing as a major attraction, will some day be established here. The United Fruit Company offered to cooperate with

the government, or presumably with any other responsible organization, in making Tela into a resort. The fruit company has reduced its activities in Tela very considerably, and comfortable staff houses, a sizeable club and other buildings could form the nucleus of a vacation resort.

Captain Henry Yates, who once ran a charter boat, and Luis Verdiguel, both employees of the United Fruit Company, spoke enthusiastically of sport fishing in the waters off Tela. Spanish mackerel, big kings, 15 to 18 pounds and occasionally up to 25 or 30 pounds, are the commonest fish caught trolling, but they take many bonito, too. Jacks can be had for the trouble of baiting a hook, while wahoos — which they call "queenfish"—come harder and less often. These grow to well over 100 pounds and are fished deep.

Bottom Fishing On "Banks"

Bottom fishing is good on the "banks" about 18 miles offshore N.E. from Tela, and here snappers, especially yellowtails, groupers, jewfish, mangrove, lane and mutton snappers and rockfish are abundant. Barracudas are also numerous and are highly regarded, as a sport fish and as food.

Spanish mackerel can be caught the year around, whenever an E.N.E. wind is blowing. Good anglers here fish by the moon; the kings for example, hitting best on the young moon, and showing up well on any change of the moon phase.

Bonitos are common and run about 4 to 5 pounds in weight. "Albacore" tunas, 18 to 20 pound beauties, appear in large numbers in the spring and can be caught by trolling fast with a feather.

Mr. Arthur Mandella, Superintendent of the Materials Department of the Standard Fruit, told us of his experiences fishing in the lagoons. Here he catches snook and tarpon, which are common near Tela.

Skin Diving, Too

The American Ambassador to Honduras, Whiting Willauer, is the leader of a small group of skin divers. This sport is gaining in popularity in the clear warm waters of the country.

Mr. Willauer was in the news a short time ago when he dived into a forty-foot pool in the river which runs through Tegucigalpa, and recovered the body of a 12 year old boy who had drowned while swimming.

Awaits Pan American Highway

On the Pacific side, in the towns around the Bay of Fonseca, there are virtually no tourists and apparently no residents with the leisure or inclination to fish for any reason but the grim necessity of eating regularly. Sport fishing was not mentioned during our visit. When the Pan American Highway is paved all the way from the United States, however, American and Mexican tourists with cameras, dark glasses, peaked caps and fishing rods will appear at San Lorenzo and Amapala. They will find food fish to catch, and this area may also provide good sport. Certainly weakfish, or sea trout, are plentiful, and groupers, snappers and snook occur in some quantities.

What of the development of the Honduran commercial fishing in-

dustry as a whole? The few small fisheries described earlier are totally inadequate to supply the country with food fish, or with income from seafood resources. Is this low level of activity the result of lack of fishery resources, or are there other reasons for it?

It appears that there are "other reasons." We are satisfied that considerably more fish could be produced if it could be sold, and, more important, if it could be delivered to the buyer regularly, in good condition, at a reasonable price.

Bad Roads A Major Drawback

Remarks about the road outside of San Pedro could, apparently, have truthfully been repeated about most other roads in Honduras—only more so. There is only one cross-country highway passing from the north coast, through Tegucigalpa, to meet the Pan American highway near the Pacific coast, and it is not hard surfaced. Indeed, even the Honduras section of the Pan American is not completely improved.

Railroads exist only in a relatively small part of the country, linking a few towns on the north coast, where the fruit companies operate. A cross-country railroad was planned many years ago, and a sizeable loan was arranged in London to finance its building. Unfortunately the money found its way into private pockets and the railway never was built. So fish cannot be shipped by rail except in tiny amounts, and a major shipping method is thus denied the country.

Planes supply the best means of transportation in Honduras, yet fish do not ship well in the fresh state, even by air.

Meat Costs Less

Again going back to the beginning, it is plain that fish are too high priced

A YOUNG VILLAGER *wades out to greet a boatload of fishermen, homeward bound at Trujillo, on the north coast of Honduras. Long narrow canoes are well suited to the type of fishing done here. (Marine Laboratory)*

in Honduras to enjoy a wide market. In the U.S.A., and in other countries where fish is widely accepted as food, it gets its share of the market only at a price below that of meat—generaliy considerably below. In Tegucigalpa and to a lesser extent in other cities in Honduras, fish is considerably *higher* in price than beef. Fish then becomes a luxury. This situation is not now conducive to the establishment of a profitable industry.

How to get fish prices down? Only the laws of economics—supply and demand—can accomplish this. Fish must be supplied plentifully and thus cease to be a luxury.

If it be true that fish are abundant enough to support heavier fishing, why not ship bigger quantities to Tegucigalpa, bring the price down, and hence increase sales? Eventually more fish must be caught if more is to be consumed, but the attack must be gradual. Flooding the streets of the capital with fish would only create a sanitary problem and, while the fish sales of the capital might double or triple at greatly lower prices, this would still be at the expense of the wholesaler.

A carefully planned, step-by-step increase of supply will be followed by additional sales. Further increase in supplies must in turn be preceded by stimulation of demand, and so on. It would be fatal to increase landings suddenly—there is simply no machinery to distribute the fish and no present demand for them.

How To Solve It

Obviously the shortage of ice and freezers in Honduras, and the lack of public understanding of the processes of fish spoilage, all combine to make the quality of sea food products rather low. Education in handling fish and the merits of sea food, plus the gradual introduction of ice plants can correct this situation, and the consumption of fish will rise.

Actually education is the key to the situation. The people of Honduras do not eat fish because they have never had a chance to do so. All of us eat what we are brought up o and it is unlikely that even the prese tation of fine quality, low-priced fisu in large quantities to the Hondurus people would immediately persuade them to eat it with any real enthusiasm. If the children are fed good fish and come to acquire a taste for it while their tastes are being formed, however, fish may very well become an important item of diet in Honduras, as it has in many other Latin American countries.

Age of Man and the Sea Floor

By CESARE EMILIANI
The Marine Laboratory, University of Miami

CORES TAKEN from the sea bottom are opening up a new frontier in the study of the history of the earth. Surprisingly, these deep sea sediments may today help to establish the date when primitive man appeared on the ancient land far away from the ocean floor. To understand how a sample of mud from the ocean floor may act as a time clock for man's evolution, we must first consider the way in which this mud is formed.

Deep sea sediments accumulate very slowly. The abyssal "red clay," for instance, found on the bottom far at sea, accumulates at rates of only about one inch in 25,000 years. The sediment known as "Globigerina ooze" builds up somewhat faster at rates of about ten inches in the same time interval.

The latter, a chalky deposit, covers almost half of the surface of the deep-sea floor, and is composed almost entirely of shells of tiny creatures known as foraminifera—single-celled marine animals which grow hard shells, usually less than 1/32 of an inch in diameter.

More than 50,000 species of living and fossil foraminifera have been identified. Most of these live or lived on the bottom, from inshore waters to abyssal depths. Other species float freely near the surface. They are known as "pelagic" foraminifera and include about 30 species existing today.

Sampling the Bottom

How is it possible to get a sample of sea bottom sediments? Most such samples are obtained by corers, special devices of the deep sea scientist. Essentially, they are metal tubes which are lowered from ships and forced into the ocean floor by lead weights.

With an improved type, the piston corer, developed by the Swedish scientist Börje Kullenberg during World War II, sediment samples are currently obtained to a depth of more than 100 feet below the surface of the oozy sea bottom. In the case of Globigerina ooze, sediments deposited more

HOLD OLD IS HE? *Through study of sea cores, strangely enough, scientists can now estimate the age of even such primitive types of man as* Homo erectus *(Sinanthropus Pekinensis) whose skull is shown here. (Smithsonian Institution)*

than a million years ago may thus be reached.

More than 300 long deep-sea cores were collected by Kullenberg during the world-wide Swedish Deep Sea Expedition of 1947-8. Later a large number of similar long deep-sea cores were collected in various parts of the oceans by scientists of the Lamont Geological Observatory, the Woods Hole Oceanographic Institution, and the Scripps Institution of Oceanography.

EXPLORER OF ABYSSAL DEPTHS. *The piston corer, first developed by the Swedish scientist Börje Kullenberg, can obtain sediment samples to 60 feet below the surface of the oozy sea bottom. Lead weights force it into the ocean floor. (M. Woodbridge Williams, National Geographic Society)*

Temperature a Clue

A temperature change at the surface of the ocean generally affects the living pelagic foraminifera in a number of ways, but especially in changing the relative abundance of species having different temperature tolerances. The effect of such temperature changes will be preserved in the deep sea sediments as the shells of the dead accumulate there. In this way the past temperature changes can be estimated by accurate biological investigations.

However, past temperatures of the ocean may be studied more exactly by the "isotopic thermometer." This method, devised and developed by Professor Urey, at the University of Chicago, is based on the fact that oxygen has three kinds of atoms — the common isotope, known as oxygen 16, the heavier, less common isotope, oxygen 18, and the much rarer oxygen 17.

Calcium carbonate in sea water, from which the foraminifera shells are formed, contains all three isotopes. The ratio of oxygen isotopes in the shells varies with the temperature of the sea water at the time they are formed. Thus, a change of one degree Centigrade produces a change of 0.2 per mil in the ratio of oxygen 18 to

oxygen 16 (oxygen 17 is disregarded because of its rarity).

It is therefore possible to measure the temperature at which a calcium carbonate depositing marine fossil lived by measuring the above oxygen isotope ratio in its carbonate material. This measurement is made by means of a high precision mass spectrometer.

Secrets from Deep-Sea Cores

Application of Urey's method to pelagic foraminifera from deep-sea cores has made possible a detailed reconstruction of temperature variations of ocean surface waters during the last 300,000 years, when many continental areas were repeatedly glaciated. A number of deep-sea cores, collected by Börje Kullenberg in the Atlantic, the Pacific, and the Mediterranean, and by Maurice Ewing in the Caribbean, were studied.

The cores were sampled every ten centimeters, and the pelagic foraminifera were analyzed isotopically. The temperature curves obtained show a number of alternating high and low temperature extremes, corresponding to the interglacial and glacial ages of the last geologic epoch, the Pleistocene.

The different temperature curves correlate very well among themselves, and have been combined into a generalized temperature curve (see chart). An absolute time scale was attached to this curve on the basis of radiocarbon measurements made on the upper portions of various cores by Rubin and Suess, at the Radiocarbon Laboratory of the U.S. Geological Survey in Washington. In addition, ionium measurements by Picciotto and ionium-radium measurements by W. D. Urry have been used.

The time interval of 300,000 years, covered by these cores, represents about one half of the Pleistocene ep-

TIME CLOCK FROM THE SEA BOTTOM. *Extruding a long sediment sample from an improved type of piston corer. Because abyssal deposits accumulate so slowly, each inch of a core may represent thousands of years. (M. Woodbridge Williams, National Geographic Society)*

och. It was during this time that the continents were repeatedly glaciated.

Modern Man Evolved 100,000 Years Ago

The generalized temperature curve shows, below the present high temperature, a minimum at about 18,000 years ago, corresponding to the time of the maximum southward advance of the ice in North America and Europe during the last glaciation. The preceding temperature minima are believed to correspond to previous glaciations of the Pleistocene epoch. A correlation between the generalized temperature curve obtained from the deep-sea cores and the glacial and interglacial deposits of Europe is shown in the first column of the chart. This correlation is practically sure back to about 100,000 years ago, less sure for earlier times.

Oldest Human Fossils

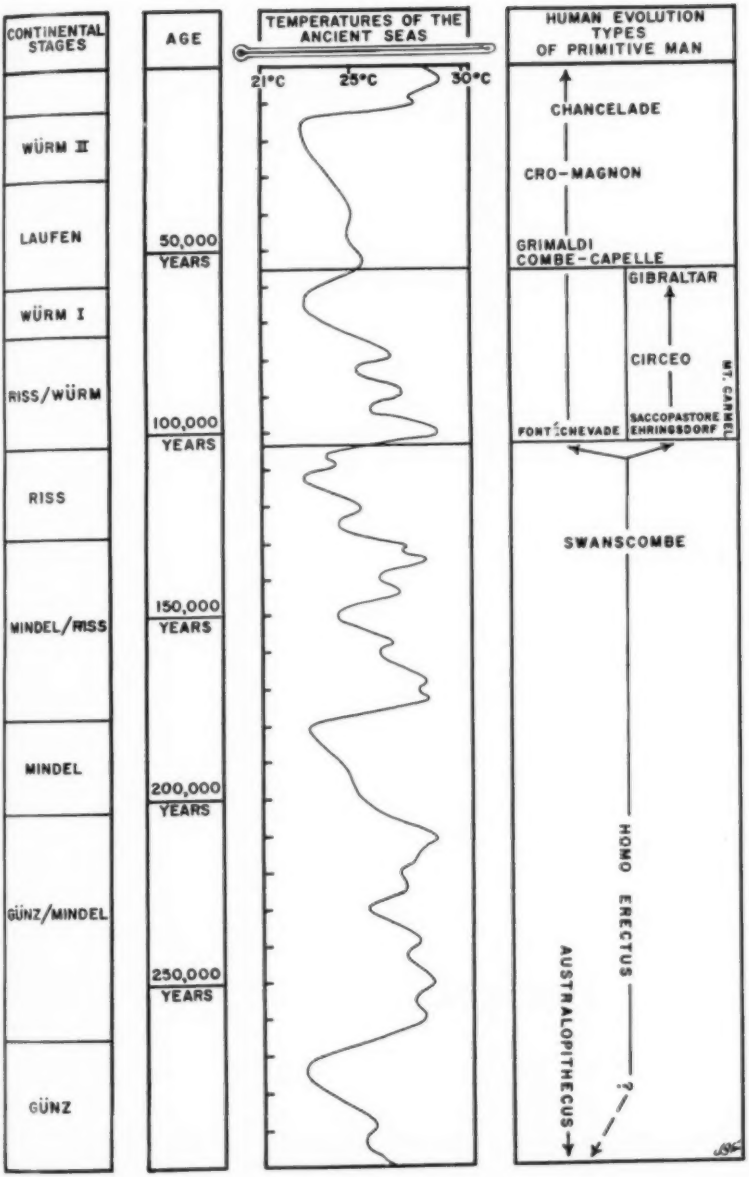
The position of many fossil human ancestors, with respect to the glacial and interglacial events of the continents, is reasonably sure. It is known, for instance, that Neanderthal man spread from the last interglacial to the temperate Würm I - Würm II interval; that the Fontéchevade remains belong to the last interglacial; and that the Swanscombe skull bones belong to the close of the Mindel-Riss interglacial. It is thus possible to correlate the position of these and other fossils of early man with the temperature curve obtained from the deep-sea cores. Since an absolute time scale is available for the latter, absolute dating of the fossils results.

One may see from the chart that

TEMPERATURE CURVE *for the and seas (center) obtained by analysis deep sea sediments. The left column the various* glacial and interglacial *stages of the continents. Würm II Würm I are the two phases of the glaciation; the Riss, Mindel and G are names of preceding glaciati Günz, being the earliest. Names bet refer to interglacial stages. The* scale (age) *shows how many years these occurred. The names in the hand column refer to* human and human fossils.

the Fontéchevade remains, which are the oldest fossils belonging to modern man (*Homo sapiens sapiens*) are about 100,000 years old, while the Swanscombe skull bones, probably belonging to an ancestral subspecies (*Homo sapiens praesapiens*), are about 130,000 years old. Therefore, the differentiation of modern man should have occurred between 130,000 and 100,000 years ago. *Homo erectus* (the so-called Java and Peking men, also named *Pithecanthropus erectus*) appears to be 200,000 to 250,000 years old. This suggests that the differentiation of the species *Homo sapiens* should have occurred between 200,000 and 130,000 years ago.

The Australopithecinae, the famed man-apes of South Africa, seem to date from several to two hundred and fifty thousand years ago. The genus *Homo*, to which all the primitive men belong, may have evolved only from the *early* Australopithecinae, if at all. In fact, the *late* representatives of this group seem to have been contemporaneous with *Homo erectus*. Many believe, therefore, that both *Homo*


CONTINENTAL STAGES
AGE
TEMPERATURES OF THE ANCIENT SEAS
21°C
25°C
30°C
HUMAN EVOLUTION TYPES OF PRIMITIVE MAN
WÜRM II
LAUFEN
WÜRM I
RISS/WÜRM
RISS
MINDEL/RISS
MINDEL
GÜNZ/MINDEL
GÜNZ
50,000 YEARS
100,000 YEARS
150,000 YEARS
200,000 YEARS
250,000 YEARS
CHANCELADE
CRO-MAGNON
GRIMALDI
COMBE-CAPELLE
GIBRALTAR
CIRCEO
MT. CARMEL
FONTÉCHEVADE
SACCOPASTORE
EHRINGSDORF
SWANSCOMBE
HOMO ERECTUS
AUSTRALOPITHECUS
?

and *Australopithecus* were derived from earlier, yet unknown, anthropoids.

More Cores Needed

The disappearance of the Australopithecinae can be dated at about 250,000 years ago, on the basis of the generalized temperature curve of the deep-sea cores, but they extend further back in time than this curve. When longer deep-sea cores become available, it will be possible to extend the generalized temperature curve back to perhaps a million years ago, and to date better the Australopithecinae. On the other hand, refinements in interpretation of the deposits where many fossil hominids not mentioned here were found, may make possible their inclusion in the chart, thus completing the record.

The evolutionary root from which arose the sequence of Australopithecus to *Homo erectus* and thence to *Homo sapiens* is very obscure, because of the insufficiency of the fossil record. A possible ancestor is *Oreopithecus,* a fifteen million years old fossil from Tuscany. It has been maintained, in fact, that *Oreopithecus* is closer to ancestral Australopithecinae than to true apes of that time. The solution of this and many other fundamental problems of the evolutionary process which resulted in the emergence of modern man may have to wait until many more fossils have been discovered.

From the dates mentioned previously one may deduce that differentiation from *Homo erectus* to *Homo sapiens* took probably not more than about 75,000 years, corresponding to about 3,000 generations, and differentiation from *Homo sapiens praesapiens* to *Homo sapiens sapiens* took not more than about 30,000 years, or about 1,200 generations.

The discovery of the Fontéchevade remains, rather surely belonging to modern man, clearly indicates that the Neanderthals (*Homo sapiens neanderthalensis*) belong to a separate branch of humans, which evolved in parallel with modern man. The Neanderthals appear to have originated about 100,000 years ago and to have become extinct about 50,000 years ago, involving only about 2,000 generations.

Man Evolved Fast

It is evident that human evolution was surprisingly fast. This was probably due to the low density of the ancient human and pre-human populations, and its division into numerous, small groups genetically isolated. Presently, the human population is very large and it mixes quite freely, so that little room remains for human evolution in the future.

High Seas Fish Swims to Laboratory!

THE UNIVERSITY of Miami Marine Laboratory sends research vessels on many cruises in order that marine biologists may study the secrets of pelagic or open sea fish, using expensive nets, tackle and other gear to obtain specimens.

On February 10, 1958, a very rare oceanic fish, the sharp-tailed sunfish (*Masturus lanceolatus*) returned their calls, so to speak, by stranding itself alive on the beach along Bear Cut, Virginia Key, directly in front of the Marine Laboratory.

From a small boat, and using only their bare hands, three graduate students of the Laboratory (in photo, from top to bottom, Edward Klima, Thomas McKenney, and Alan G. Lewis) captured the 300-pound oddity, and managed to hold it until a collecting-boat from the nearby Miami Seaquarium could take it in tow.

The big visitor was placed on exhibit in the main tank there with a *Mola mola,* a more common species of sunfish, which the Seaquarium had obtained only the previous day from a charter boat operating in the Gulf Stream off Miami Beach. Incidentally, these big oceanic sunfish are related to the trigger fishes, and not to the common fresh water sunfishes.

For a photograph of a *Mola mola* out of the water see Volume 2, No. 3, page 165.

IDEA TRADERS *at the Second Game Fish Conference. Four delegates, left to right, Robert E. Maytag, Dr. John Randall, Robert W. Ellis, and Dr. Gilbert L. Voss, pause between sessions at the Empress Hotel, Miami Beach, Fla., November 16, 1957. (E. John Long)*

Game Fish Conference

By ERL ROMAN

THE SECOND ANNUAL Game Fish Conference, on November 16, 1957, at the Empress Hotel, Miami Beach, was both an enjoyable and instructive occasion. Progress since the first meeting at Nassau, in 1956, has been excellent, and promises well for the future.

Under the sponsorship of The International Oceanographic Foundation this annual gathering of experts in many fields cannot fail to unite the world of sport fishing with scientific endeavor for the benefit of all.

Objective of Conference

The main objective of the Game Fish Conference is to assemble, in one annual meeting, salt water anglers, fishing guides and marine scientists, to the end that each group can learn and also teach through personal contact. Summed up, it means that an-

glers and fishing guides obtain factual information that will enable them to employ better fishing and conservation methods, while scientists gain considerable knowledge of game fishes that otherwise would be unavailable or lost.

Best of all, however, is the development of new trends—anglers and fishing guides are leaning more and more toward scientific research, while scientists are getting a whole new concept and appreciation of the salt water angling world. Thus, cooperation between these groups is being solidly cemented, and the future of salt water fishing looks bright from both the scientific and sports points of view.

Eight Excellent Papers

The Game Fish Conference brought out eight excellent papers, some prepared by scientists and some by anglers, on many and varied facets of sport fishing and game fishes. One of these papers related to spearfishes in the western Atlantic Ocean, while another described the fine fishing available in the Gulf of Panama.

White marlin fishing in the Gulf of Mexico was featured in one paper, while a fourth gave highlights of the important John K. Howard Billfish program. Other papers reported on marlin fishing in Puerto Rican waters, game fishing off the Venezuela coast, an up-to-date zoological exhibition of game fishes, and a survey of Florida's salt water sport fishery.

The papers without exception were informative and of reference value. Space does not permit full comment on their contents, but they will be made available in mimeographed form, and anyone interested in a particular paper, or in any number of them, can obtain copies by writing to The International Oceanographic Foundation, 439 Anastasia Ave., Coral Gables 34, Fla.

Panel Develops Ideas

The morning session, at which papers were read, was conducted by Dr. Gilbert L. Voss, of The Marine Laboratory, University of Miami. The afternoon was given over to a panel discussion and development of the information contained in the papers. Under the chairmanship of John S. Gottschalk, acting chief of the Sport Fishing Section of the United States Fish and Wildlife Service, the discussion covered practically every phase of salt water sport fishing, including its relationship to conservation and the marine sciences.

The annual meeting of the Board of Trustees of The International Oceanographic Foundation, under the chairmanship of Mr. Charles F. Johnson, president, was held the day prior to the Game Fish Conference. The report of the secretary, Dr. F. G. Walton Smith, proved to be most gratifying, revealing great advancement during the past year. This was true not only in the increase of the number of members, but also in the number and amount of donations received.

Chair of Ichthyology

A new member, Robert E. Maytag, of Ponte Vedra Beach, Florida, was elected to the board by unanimous vote. Mr. Maytag has provided a Chair of Ichthyology for The Marine Laboratory. He is a salt water angler of considerable experience, and was

one of those who presented papers at the Game Fish Conference. During the past several years, Mr. Maytag has become interested in the scientific aspects of salt water fishing and has cooperated with marine scientists by furnishing them with pertinent data, such as water temperatures, water samples, stomach contents of various game fishes he has caught, and specimens of the fish themselves.

One of the matters discussed at the meeting of the Board of Trustees was a plan to correlate game fishing information throughout the world. Scientific institutions seeking information about the distribution of fishes need a means of communicating with the angler. Similarly, anglers would like to know how they can assist those engaged in research and would like to be in touch with research institutions to know the kind of data required. They usually lack also such useful information as hotel accommodations and rates, fishing cruisers available for charter and their equipment, and the hundred and one things that go to make an angling or collecting trip a success.

The International Oceanographic Foundation will attempt to collect such data and place them at the disposal of marine laboratories and salt water anglers everywhere. The comments and suggestions of both anglers and scientists in this respect are cordially invited.

Science of the Sea in Books

SEASHORES

HERBERT S. ZIM AND LESTER INGLE. Simon and Schuster. New York, 1955. 160 pp., numerous color illustrations. $1.95.

Another addition to the popular Golden Nature Guide series edited by Dr. Zim, this guide to the life of the seashore should find a ready sale among the large and growing number of amateur naturalists and nature lovers who roam our nation's beaches from Maine to Florida and the Gulf Coast, as well as from Washington to southern California.

Well-written and informative, and with 458 species of animals and plants illustrated in full color by the able brushes of Dorothea and Sy Barlowe, it attempts to illustrate and give some information on the life and habitat of a selected number of invertebrate animals, marine and maritime plants and shore birds of both the Atlantic and Pacific coasts.

The informed reader will undoubtedly miss certain well known forms which he might wish to see figured instead of some lesser known species, but this is inevitable in a field guide of such scope, and the authors have done an excellent job of selecting the representatives given. As is usually the case when scientific names do not accompany the figures, many common names have obviously been manufactured by the authors, sometimes leading to confusion and lack of clarity. The list of scientific names at the back of the book partially helps to clarify this if the reader wishes to search through the rather long list. The illustrations are well done in general but occasional lapses occur, such as the figure of the two-spotted octopus without its spots or ocelli.

Of particular interest to the general reader will be the sections on animal habitats, life histories, food and feeding, economic value, family trees and information on how, when and where to collect marine life. There is even a partial list of institutions where one may obtain information on marine life or identifications of animals not covered in the book. This little volume is well written for both young people and adults and deserves a place in every beachcomber's library.

G. L. V.

ELASTIC WAVES IN LAYERED MEDIA.

W. MAURICE EWING, WENCESLAS S. JARDETZKY, AND FRANK PRESS. McGraw-Hill, New York, 1957. 380 pp. $10.00.

The pioneer work carried out at the Lamont Geological Observatory on the propagation of sound in the ocean and the sea-floor is here presented as a survey of wave propagation, with the boundary conditions apropriate to oceanography, seismology and geophysics in general.

The book begins with careful development of the equations of motion of elastic media, ideal fluids and imperfectly elastic media (i. e. those exhibiting internal friction). These are then reduced to the corresponding wave-equations. After the general properties of wave-solutions are discussed, boundary conditions pertinent to geophysics are dealt with. In particular: half-space, interface, and layered half-space boundary problems are treated.

A chapter is devoted to the study of the modifications of the foregoing theory demanded when gravity, terrestrial curvature and viscosity are admitted. A chapter follows in which wave propagation in plates and cylinders is studied. The chief geophysical value of this portion of the work is its application to the recently studied phenomena of wave propagation in ice-sheets and ice-islands.

The book concludes with a valuable chapter on the transmission of waves in media in which the velocity is position dependent. An analysis of SOFAR transmission in the deep sound channel is given, and there is a discussion of Love and Rayleigh waves in the earth's crust.

Much attention is given to the determination of analytic solutions of wave-problems. Since the solutions are usually higher transcendental functions, and since the physical interpretations are somewhat limited, the analytic portions are best recommended to specialists. However, much information is conveniently presented in graphical form (especially curves of phase and group velocity vs. wave period) experimental investigators may also benefit from the analyses given.

R.B.

Oceanic Pasture For Fish

The Grand Banks consist of a shallow water shelf in the Atlantic off Newfoundland. Here the cold Labrador Current meets the warm Gulf Stream. The swirling waters provide conditions favorable to the growth of plankton, and make a rich oceanic pasture for fish. Commercial fishermen have been filling their ships with cod and other fishes from the Banks for 450 years, with no evidence of depletion.

About The Authors

JOHN A. MANNING

Although a well-known big game angler, Mr. Manning has a deeper interest in the ocean than merely sport recreation. His scientific training was obtained at the University of Southern California and at the California Institute of Technology.

A director of the John A. Manning Paper Company, he also found time for training as an aircraft pilot and was a test pilot for Lockheed during World War II. But his enduring interest has always been in fishing and hunting. Some indication of his ability, and his enthusiasm for big game fishing, may be noted in the fact that he was a member of the U. S. International Tuna Team for six years, and is a past president of the Tuna Club of California, in addition to being a member of the British and Scandinavia Tuna Clubs.

Mr. Manning has taken the largest game fishes, including bluefin tuna, marlin, and swordfish from such diverse places as Chile, Peru, Ecuador, Nova Scotia, California, Mexico and the West Indies. Eventually, however, his interest was transferred from angling to the scientific study of fishes and the sea. In 1954 he took part in the University of Miami - Lou Marron Expedition to South America. Since then he has conducted, as a field associate of the Miami Marine Laboratory, extensive field surveys of the pelagic fishing potentials of Chile.

SIGMUND M. MILLER

Like many others who saw military service in the Pacific during World War II, Mr. Miller developed a latent interest in marine science, although he confesses that it was then confined largely to collecting sea shells. Following the war he attended University of Miami and received his Bachelor of Science degree in 1949. A year later he took up marine science as a career, combining it with chemical studies at the University's Marine Laboratory to obtain an M.S. degree in 1951.

Joining the staff of The Marine Laboratory, Mr. Miller spent a year assisting in the study of the hydrography and

productivity of the Florida Current off Miami. His present specialty is problems of deterioration of materials exposed to marine environments. Mr. Miller is a recognized expert in research concerned with marine antifouling and anticorrosive cotings, marine borer control and corrosion mitigation.

CESARE EMILIANI

Cesare Emiliani was born in Bologna, Italy. He became interested in the Pleistocene shortly afterwards, having discovered Pleistocene fossils in his backyard. This interest was considerably deepened when he was driven underground by war events, the hills surrounding Bologna being largely formed by Pleistocene sediments. Having obtained a doctor's degree from the University of Bologna at the end of the war, he worked for two years with an improbable oil concern located in Florence. "We did not discover any oil and, therefore, I went to Chicago." He obtained a Ph.D. in Geology from the University of Chicago in 1950 and then joined Dr. Urey's team working on paleotemperatures. He was put in charge of this project in 1952 and remained there until a year ago, when he joined The Marine Laboratory, University of Miami, as associate professor of marine geology. He wrote some twenty papers during this time, stimulated by the fact that it is unwise to be out at night in Chicago. Some of his papers represent fundamental advances in the field of Pleistocene geology, and have won international recognition. Dr. Emiliani was recently elected chairman of an international commission to study deep-sea sediments. He smokes a deadly stuff called "spuntatura" and can brew an excellent *espresso* with no accessories except coffee and water.

GILBERT L. and NANCY VOSS

Dr. Voss is one of those rarities, a native Floridian. He grew up on the sea as a commercial fisherman and sailfishing guide, serving for four years in the Coast Guard during World War II, part of the time in the Central Pacific. He graduated from the University of Miami with a Bachelor of Science degree and received his Master's at the same institution. He received his doctorate from George Washington University. With his varied marine background he early turned his interest to the sea life around Miami and has written on subjects from the life history of the sailfish to larval fish development and octopi and squids.

Mrs. Voss was graduated from Mt. St. Agnes College in Baltimore with a Bachelor of Science degree and received her Master of Science degree from the University of Miami where she took her first course in Marine Biology from her husband. Her biological interests revolve around studies of larval fishes and invertebrate ecology which, however, have been interrupted by raising two small children. Even with these distractions she is continuing studies on shallow water ecology. Together they are carrying out studies of reef habitats in the Bahamas and Florida.

Progress

IN THE SHORT PERIOD of its life, *Sea Frontiers* has now reached a circulation of 12,000, not all of whom are members. They are drawn from the United States, Canada, Central and South America, Great Britain, Australia, France, Germany, Italy, Denmark, Sweden and Norway, as well as a few from the Pacific Islands and the West Indies. Continued improvement will be possible with growth of active membership. It will be seen in better service, with more articles in the Bulletin of high interest and authenticity and, eventually, a monthly issue in full color.

Members are joined in these aims and they are urged to make progress possible by taking the small effort needed to enlist new members. To those who are not members, but whose interest and curiosity lie in the sea and the spirit of discovery, there is extended an invitation to participate by simply mailing a card. The ocean is our last frontier and its exploration still under way.

The editor will be glad to consider for publication articles and illustrations covering explorations, discoveries or advances in our knowledge of the marine sciences or describing the activities of oceanographic laboratories or expeditions in any part of the world.

The International Oceanographic Foundation

"To encourage the extension of human knowledge by scientific study and exploration of the oceans in all their aspects, including the study of game fishes, food fishes, ocean currents, the geology, chemistry, and physics of the sea and the sea floor."

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The Foundation was established by a group of saltwater anglers, yachtsmen, shipowners, marine scientists and others interested in the scientific exploration of our last frontier, the ocean. Its objectives are to provide support and encouragement for marine research, exploration and discovery and to promote the collection and dissemination of scientific knowledge about the ocean.

Qualifications for membership are an interest in the oceans and a desire to extend and develop scientific research and exploration into them. Support given to research through personal activities or donations is recognized by the Foundation through the following classes of membership. Members are those who make annual contributions of $5, Fellows $25 annually; Associates $100 annually; Life Fellows are those who contribute $200 or more or who have otherwise helped to advance the purposes of the Foundation; Sponsors who contribute $1,000 or more; and Patrons who contribute $5,000 or more.

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One of the larger research vessels engaged in oceanographic studies in the Geophysical Ye